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Schedules for Locomotive Repairs

The advantages to be obtained through the use of a system of schedules in making repairs to locomotives need no enlarging upon. Locomotive repairs are, however, of a nature that makes the preparation of such a schedule difficult. Flexibility is required to a considerable extent; but there is no obstacle that is insurmountable, and considerable success has attended the gradual development of the system in use at the Angus shops of the Canadian Pacific, which is described elsewhere in this issue. This system has been worked out in conjunction with that of inspection, and the organization adopted is such that the two systems are largely interwoven. A point in connection with the inspection work that is worthy of emphasis is the preliminary inspection of the locomotives immediately after their arrival. Anyone familiar with the length of time engines frequently stand obstructing the erecting floor in some shops, while awaiting the arrival of a casting or other part that has not been found to be missing or broken until the engine is in the shop and stripping has commenced, will quickly see the advantage of this practice. If a schedule system is laid out on a firm basis it will naturally broaden and develop as it continues in use, and it is not difficult to foresee the possibility of the close determination, on the day the engine is taken in the shop, of what the cost of making the necessary repairs will be. The advantage of this knowledge to the shop superintendent in laying out his work to suit his appropriation, can readily be seen.

Economizing in Cab Curtains

About this time of year side and back curtains and their rods are removed from locomotives. Quite likely they are thrown in an out of the way corner of the engine house and left there; some of them will become damp and the canvas will rot, or if any of the engine house men need a piece of canvas for any purpose during the summer the curtains will form the supply. When the weather again becomes so cold that enginemen refuse to go out without side and back curtains, the remains will be resurrected and a general survey made. By means of considerable patching, enough curtains for half the engines at the terminal may be found; the other half remain curtainless until a new supply of canvas can be ordered and new curtains made up. Beside the resultant discomfort to enginemen and trouble for the engine house foreman, this practice is expensive to the railway company. It constitutes one of the small leaks that can very easily be stopped. It is a simple matter to look over a set of curtains when they are removed in the spring and decide whether or not they need repairing. If they are in good condition they can be locked up in a suitable place under the charge of the storeman, after being tagged with the class (and, if thought necessary, the number) of the locomotives for which they are suitable. Curtains that need repairing are then tagged in the same way and sent to the

general shops, where they are overhauled. The superintendent of motive power is furnished with a list, showing the curtains on hand in good condition and those sent in for repairs. The general shops, when the repairs are completed, send in a similar list showing the good curtains on hand. When cold weather returns the head of the motive power department then knows, regardless of how much the power may have been shifted during the summer months, just where each set of curtains is, and he can order them applied or shipped elsewhere for application so that each locomotive will be provided with them when they become necessary.

Railway Accidents

A study of Accident Bulletin No. 48 recently issued by the Interstate Commerce Commission for the year ending June 30, 1913, discloses the fact that much needs to be done by everybody connected with railroads to reduce the number of accidents. This does not mean, however, that railroading is any more hazardous than a good many other industrial operations. For instance, the United States Bureau of Mines recently issued statistics showing that the mortality rate in the coal mines during the year ending June 30, 1913, was 3.82 for every 1,000 men employed, while the rate for the railways is only 2.2 for every 1,000 employees. Automobile fatalities have also grown with alarming rapidity with the increasing use of these vehicles, and in New York state alone in one year more people were killed by automobiles than were passengers by all the railroads in the United States.

A fair comparison of the accidents on railways with other industries and means of transportation will not show that railroad operation is any more hazardous. But, of course, it is the desire of everyone to prevent, so far as possible, injury and death to others, and there is an opportunity of decreasing the number of accidents on railways. The accident bulletin above referred to shows that out of 171,417 railway employees injured 54,554 were injured in and around shops. This is the largest item mentioned in the table of casualties, and is about 32 per cent of the total number. It is expected, however, that this number will be greatly reduced as time goes on, when the "safety first" movement is adopted by all the roads and becomes more carefully organized.

Another item which it behooves the mechanical department of the railways to watch closely, is the derailments caused by defects in equipment. While only 1,245, or 19 per cent of the total number of people injured in derailments, were injured on account of defective equipment, the loss in money far exceeded that of any other cause mentioned under derailments, it being $3,421,037, or about 41½ per cent of the total amount. The defective equipment is classified under wheel failures, truck failures, brake equipment failures, axle failures and draft gear failures. The most disastrous of these were the wheel failures, which caused 28 per cent of the total number of accidents from this cause, and cost the roads $1,163,129, or 34 per cent of the cost of derailments due to defective equipment. From an analysis of the causes of these derailments it would seem that they could have been prevented by more careful inspection.

Excessive Weight in Rolling Stock

Attention has been drawn, on a number of occasions in these columns, to the futility and false economy of selecting a design for a freight car on the basis of first cost alone. All railway expenditures, particularly under present day conditions, must of necessity be kept as low as is consistently possible, but the practice is not consistent, of buying cheap cars and later paying heavy maintenance charges on them while they stand out of service on repair tracks. There is, however, another important consideration which must not be lost sight of in the efforts to design a car that will be strong enough to withstand the usage of modern operating conditions. This is the question of excessive weight, and is one that has been repeatedly referred to by H. H. Vaughan, assistant to the vice-president of the Canadian Pacific.

It may quite pertinently be asked, in this connection, if it is not cheaper to occasionally have a car broken up because of insufficient strength than to pay out money in operating costs for hauling the excessive dead weight contained in some of the cars of recent design. It is a comparatively easy matter to design a car that will withstand the heaviest service required by present day conditions, provided the weight is not a factor; the problem is to produce a car of reasonable strength that will spend a minimum of time on repair tracks while accumulating the least possible amount of claims for damaged and missing freight, and at the same time be of a weight that will assist to the greatest degree in keeping down the cost of train operation. No car can be built that will run indefinitely without repairs. It has never been seriously contended that cars should be designed with a view to eliminating the necessity for repair tracks; but there should be a mean somewhere between the car that is cheap in first cost with resultant high maintenance charges and damage claims, and the car that, while standing up under the most severe service, is excessively heavy. Mechanical department men are too prone to look only at their own side of this question. It is very easy to become absorbed in the reduction of department expenses and overlook an increase in the cost of moving the company's business; and it requires no expert calculations to show the amount to which a few thousand pounds extra dead weight per car may swell the total of non-revenue ton miles.

It cannot be said that the matter of excessive weight has been or is being entirely neglected by car designers, but it does seem as if it had been accepted by many as a direct product of modern conditions, and therefore a necessary evil. This applies to passenger equipment as well as to freight. The careful consideration necessary in deciding on the design of steel passenger train cars was brought out clearly in the following statement contained in a paper read before the New England Railroad Club on February 10, by F. M. Brinkerhoff:

"Assuming that the cost of power for hauling one pound of car weight per year averages one cent, and, in rapid transit service this cost is usually safely assumed as five cents, it is obvious that, before a railroad company adopts a method of steel passenger train car design, time will be well spent for an investigation of the most searching and conscientious character into the various methods of constructing steel passenger train cars in order to secure for service a car of minimum weight, though still possessing suitable strength and all other necessary characteristics."

Until recently, American locomotive designers gave too little consideration to the question of dead weight. The increasing sizes of locomotives have at last forced them to the employment of refinements to keep weights within reasonable limits. Conditions indicate the necessity of following similar lines in car designing.

The Draft Gear Competition

The manufacturer of a car roof complained bitterly that his roof was not given a fair show on a large order because the cars were not equipped with an adequate draft gear which would absorb the shocks and act as a protection to the rest of the car. The general manager of a railroad says that the damage to lading in the freight cars would be very considerably reduced by the application of better draft gears to the freight cars. A superintendent of motive power claims that the maintenance of his freight cars is much higher than it should be and that the application of higher capacity draft gears would reduce this cost to a more reasonable figure; the added cost of the higher grade gears would be much more than offset by the savings which would result. A master car builder is authority for the statement that an overcrowded and congested repair point would be relieved, and in fact would be

much larger than necessary if it were not for the damage which is caused by the use of low capacity draft gears on freight cars. In each case a request for exact figures as to the loss caused by the inferior gear or the saving which might be made by the application of a higher grade gear was met with the reply that it was impossible to present exact figures, but that experience would demonstrate the truth of the statements. While this may be true, the executive who is responsible for the heavy expenditures which would be involved cannot be too severely criticised if he insists that he must have more exact data on which to base his course of action.

One might naturally expect that an answer to his demand for such information would be found in the proceedings of the Master Car Builders' Association, which has done such effective work in standardizing and improving conditions pertaining to rolling stock. Unfortunately this is not the case. While it is true that very extensive tests of the various types of draft gears have been made by this association, they were carried out under conditions which are not at all comparable to those met with in service. In a report of the coupler and draft gear committee in 1909, under the head of Friction Draft Gear, we find this statement: "In order to procure definite information on the performance of existing gears, as well as information from which to base future designs, it is believed that the following policy should be followed: First, the carrying out of a comprehensive series of service tests with accurate recording devices; and, second, the design of a laboratory testing arrangement which will subject the gears to approximately the same pressures and shocks as received in service. With the above in view, a study of previous tests has been made, but although data of exceeding interest have been placed at the disposal of your committee, by both railroad companies and manufacturing concerns, there is really little definite knowledge available. . . . As mentioned in the report of last year, the good friction gears are undoubtedly an improvement in protecting equipment from constant severe shocks due to their greater capacity and to their ability to absorb the force of the blows instead of returning it to the cars in the form of recoil as is done by the spring gear."

The report of the same committee at the 1910 convention of the Master Car Builders' Association suggested that after careful consideration it was decided that it would not be feasible to study the performance of draft gears by means of a series of road tests with accurate recording apparatus, but that the use of a laboratory testing apparatus which would approximate service conditions would give satisfactory results. The design of a pendulum testing machine was presented which it was believed would fulfill these conditions, and the committee closed its report on the friction draft gear with this statement: "Your committee regrets that it has been unable to perfect the machine in time to have had a series of tests made during the past year, but it expects to have the machine set up and make a series of tests of all kinds of friction draft gears now on the market, submitting a complete report at the convention of the year 1911 on the efficiency of friction draft gears." For some reason or other the subject was dropped by the coupler and draft gear committee and no mention of it occurs in any of the three succeeding years, 1911, 1912 and 1913. This was undoubtedly because the committee has had to give a very great amount of time and investigation during the past few years to the development of a standard coupler.

As stated in the editorial on this subject which appeared in our March issue, the real basis upon which to judge the merits of the different draft gears must be on their service performance. Thus far only one railroad officer, J. C. Fritts, master car builder of the Delaware, Lackawanna & Western, has published any accurate data as to service results of different types of gear. This was presented at the September meeting of the Central Railway Club, and has been commented on at various times in these columns. Undoubtedly there are other railway officers who have made similar investigations or who have in their possession reliable data on the draft gear subject which will be of much value to the railroads generally. With this in mind we propose to offer a prize of $100, as announced in our March issue, for the best article received in this office on or before May 15, 1914, on the draft gear problem. The manner in which the subject may be approached by those who wish to contribute will, of course, depend entirely upon their experience and observation; but the judges will base their decision on the facts and evidence which are presented to show what types of draft gear are giving the best results. Such articles as are suitable for publication but which are not awarded the prize will be paid for at our regular space rates.

NEW BOOKS

Electric Car Maintenance. By Walter Jackson, associate editor, Electric Railway Journal. 270 pages. 6 in. by 9 in. Illustrated. Bound in cloth. Published by the McGraw-Hill Book Company, Inc., 239 West 39th street, New York. Price $3.

The contents of this book have been selected from the columns of the Electric Railway Journal, except that some braking and wiring diagrams were added in order to secure a more extensive series of shop instruction prints. The work places in a convenient form a great deal of useful data which hitherto had been lost to most shop men within a few months after the original publication in periodical form. As a rule the methods described are such as require no costly apparatus and of a kind that can be applied to a great many situations. Among the subjects considered are mechanical appliances for train operation, the non-electrical parts of the car body, brake equipment, trucks, wheels and axles, car washing and painting, sanders and sanding devices, lubrication, bearing practice, current collecting devices, motors and gearings, control, circuit-breakers, controllers and resistances, heaters, lighting, signs and signals. The book is well printed and completely illustrated.

Work, Wages and Profit. By H. L. Gantt. Second edition, revised and enlarged. Bound in cloth. 5 in. by 7½ in. 292 pages. Illustrated. Published by the Engineering Magazine Company, 140 Nassau street, New York. Price $2.

There has probably been no book published that gives as clear an illustration of the advantages that result in certain instances from the application of the principles of scientific management, as Mr. Gantt's work entitled Work, Wages and Profit, which was first published in 1910. The explanation of the principles used in his work is so simple and clear, and the methods employed are so sensible that the book is probably the most impressive of the large number that have been published on this general subject. There are few, if any, who have had a wider experience with the practical benefits of real scientific management than has Mr. Gantt, and none who have handled more interesting problems and obtained more surprising results. In the second edition the book has been enlarged from nine chapters to twelve, the number of colored charts has been increased from six to twelve, and many additional instances of the results of scientific management are recited. Furthermore, the book gives a summation of the argument in the form of a comprehensive and entire outline of a plan of scientific management based on the policies and methods defined by Mr. Gantt.

Application of Power to Road Transport. By H. E. Wimperis, M.A., M.I.E.E. 125 pages. 4¾ in. by 7¼ in. Illustrated. Bound in cloth. Published by D. Van Nostrand Company, 25 Park Place, New York. Price $1.50.

This book is based on a series of six lectures delivered at the Finsbury Technical College. Little has hitherto been written on this subject, and there is a paucity of published experimental data to serve as a substantial basis for design. The writer has endeavored to formulate a working theory based upon such tests

as he found available or was able to make independently with the accelerometer. The book begins with a general survey of the subject and deals with the use of steam power, internal combustion engines and electricity. The resistance to motion in relation to load, speed, wheel diameter and nature of tires is considered as well as the amount of power necessary. A chapter is devoted to the measurement of power, speed and resistance, and the use of the accelerometer and loss of power in engine friction and in transmission gears. Considerable space is devoted to the general type of steam and internal combustion engines and the vehicles on which they are used. The same chapter considers the horsepower necessary per ton and the use of gearing. An ideal curve of tractive effort is given. The fourth chapter deals with the relationship of engine dimensions and gear ratios to the work to be done and takes up the design of vehicles propelled by internal combustion engines and steam engines. Braking is also considered in this chapter. There are three appendices dealing with the energy stored in a moving vehicle, brake horse power tests made by the Royal Automobile Club and a road test report form.

Locomotive Ratios. By F. J. Cole. Published by the American Locomotive Company, New York, and known as its Bulletin 1017.

The ratios used for proportioning the vital parts of locomotives in the past followed precedent and had very little practical basis, or they were largely a matter of individual preference based on the experience gained from older designs. The heating surface of firebox and tubes and the grate area were usually proportioned in terms of the cylinder volume, the ratio used depending on the nature of the service in which the locomotive was to be engaged, as well as upon the type of the locomotive. In view of the many radical changes in locomotive practice which have occurred during the past few years, it is very evident that the old empirical rules are no longer adequate. The large increase in the size of locomotives, with their correspondingly larger capacity, the development of the Mikado and Mallet types requiring very large tractive effort at comparatively slow speeds, and of the Pacific and Mountain types requiring high sustained tractive effort at high speeds, together with increased boiler pressures, increased tube lengths, larger fireboxes and the very general use of highly superheated steam, make the older locomotive ratios almost useless even for roughly approximating correct locomotive proportions. The new ratios which the American Locomotive Company presents, are based entirely upon practical considerations and the results of exhaustive tests. They have the advantage of being independent of the type, size and class of service to be performed, because they are based upon cylinder and boiler horsepower, together with proper evaporating values for firebox, tubes, flues, arch tubes and combustion chamber heating surfaces.

The bulletin gives tables of data as follows: Cylinder horsepower of saturated and superheated steam locomotives for various pressures and cylinder diameters; evaporation from tubes and flues in pounds of steam per hour per square foot for different diameters, lengths and spacing; ratio of outside heating surface to diameter and spacing of tubes; height of crown, steam space and distance from crown to roof; and location of gage cocks. In the recapitulation a concrete example is given showing exactly how the data is applied to obtain the correct proportions for a locomotive of a stated type, having weight on drivers, boiler pressure, diameter of drivers and stroke of piston given. The value of the ratios set forth in this bulletin is amply certified to by Mr. Cole's statement concluding his discussion: "The method of proportioning described has been used by the American Locomotive Company for the past three years in all their locomotive designing. Numerous road tests, and records of engines in service have been investigated and carefully checked with the ratios. These three years of service have so thoroughly proven the consistency of the method that it has been adopted as the company's standard."

COMMUNICATIONS

THE COLLEGE MAN AND THE RAILROADS

Ames, Iowa, March 21, 1914.

To the Editor:

I served three years' special apprenticeship on one of the western roads, had a few months' experience as foreman of a roundhouse, and have since been engaged in teaching, and I feel that I understand some of the conditions that the apprentice has to meet. The secret of a college man's making a success of a railway apprentice course is not materially different from making a success in any other line of work; he must be willing to do what he is told and go into the work with the spirit that looks to ultimate success.

In a special course as outlined by many of the roads there is little time for the apprentice to become very proficient in that particular line, and it naturally can be said that few earn the wages they receive; but it is my opinion that if the special apprentice shows the right aptitude for the work he will earn his wages.

A great many railway officers condemn the college man because of a few special apprentices they have known who were failures. They overlook the fact that many have proven themselves able and efficient men. It has been my observation that the attitude of some special apprentices toward the work is in a large measure the fault of the foremen under whom they are working. These foremen do not hold the men to their work as strictly as they do the regular mechanics under their charge and allow them a freedom that has a disorganizing effect as well as a tendency toward making an inefficient workman. This I know to be specially true in certain instances where the apprentice was the relative of an officer. The apprentice should be held as responsible for the quantity of his work as any other employee and should be made to understand this at the beginning of his apprentice course. When it is evident in the minds of the officers who have the apprentice directly in charge, that he is not fitted for such work and his continuing in it is useless so far as the possibility of advancement is concerned, they should so advise him.

A communication in a recent issue of this paper on this subject stated that college authorities should not permit men who are naturally unsuited for mechanical engineering work to continue in this course. This is all very well provided the college professor knows when a student is unfitted for such work. It is more difficult for the teacher to find out whether a student has natural ability as a mechanical engineer when he comes in contact with him, say one day each week, and that after he has already spent two years of his college course in the preparatory or foundation work of the course, than it is for the foreman who oversees his work day after day for several months.

The best field for advancement for a special apprentice is in starting in as a sub-foreman and getting in line for advancement to the more important positions. It is evident, however, to any close observer that good foremen are not such a common commodity that they can be picked up anywhere. A good foreman is rare, and it is natural to suppose that only a few of the college men who take up railroad work will prove competent as foremen; but this does not prove that the others have no special ability. It remains for the railroads to find places where these men can be used for efficient service.

R. A. Norman,
Associate Professor of Mechanical Engineering, Iowa State College.

A Panama Canal Every Year.—Excavations equal to the entire amount necessary to build the Panama Canal have been made in the anthracite coal fields of Pennsylvania every year since the Panama Canal was begun. The average number of net tons of coal produced from the anthracite mines during the years 1904 to 1913 inclusive was approximately 81,000,000.

Interesting Mikado Type Locomotive

Standard on the Canadian Pacific; Fitted With a Vestibule Cab; New Design of Engine Truck

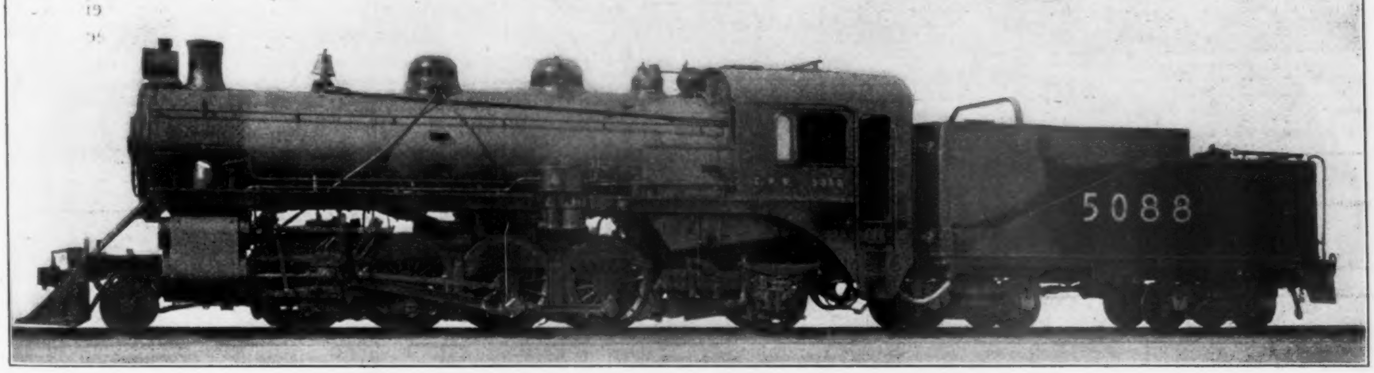
BY W. H. WINTERROWD
Mechanical Engineer, Canadian Pacific Railway, Montreal, Que.

There were built during the year 1913 for the Canadian Pacific by the Montreal Locomotive Works, 75 Mikado type locomotives with a tractive effort of 42,000 lb. With but few modifications, these engines were duplicates of 20 locomotives designed and built at the Angus shops of the Canadian Pacific during 1912.

These locomotives have 23½ in. by 32 in. cylinders, 63 in. diameter drivers, 180 lb. steam pressure, a total heating surface of 4,738 sq. ft,* and weigh 258,000 lb. in working order, with a weight of 198,000 lb. on the drivers.

On account of the necessity of keeping within permissible wheel load limits, an endeavor has been made to develop maximum power with minimum weight. In this connection it is of interest to note that with the weight of engine mentioned, a very large heating surface has been obtained.

With the exception that the boiler has been lengthened, and a trailer truck added, these locomotives are nearly identical with the Consolidation engines, previously the prevailing type of heavy freight power on this road. The practical value of such design and its beneficial effect on maintenance and repair costs is too evident to require discussion.



Canadian Pacific Mikado Type Locomotive

Although the Mikado boiler has flues 5 ft. 2⅞ in. longer and a slightly deeper throat sheet than the boiler of the Consolidation, it is a matter of interest that it is much the better steamer of the two.

It is an established fact that the Mikado type of locomotive is admirably adapted to haul slow heavy freight trains one day, and fast freight trains the next. The Canadian Pacific has gone a step farther and introduced this type of locomotive in passenger train service. The majority of the Canadian Pacific Mikados are in freight service, but a number of them have been assigned to regular passenger duty on the main line between Sherbrooke and Megantic, Que., on the Eastern division.

Between the two points mentioned the line varies 1,220 ft. in elevation within a distance of 68½ miles. From the accompanying profile it may be noted that within this distance the maximum gradient is 1.72 per cent, and the maximum track curvature is 6 deg. 7 min.

The scheduled time from Sherbrooke to Megantic is 2 hours 30 minutes. Deducting from this the time for four regular and two flag stops, the actual running time over the division averages 2 hours 15 minutes. This means an average speed of approximately 30 miles per hour.

*Equivalent heating surface.

The trains that these engines are hauling consist of ten and twelve cars, half of which are sleeping cars. Before the advent of the Mikado, these trains were drawn by the standard Pacific type locomotives, and to make the scheduled running time under adverse conditions, it was frequently necessary to resort to double heading. The Mikados have obviated the necessity for two engines, and under the most extreme climatic conditions are doing excellent work.

These engines embody a number of interesting features, chief of which is the engine truck. Instead of using the truck commonly known as the swing link type, a design has been used which carries the weight transmitted to it on a pair of double face centering wedges. On account of the use of these wedges the trucks are commonly called wedge trucks.

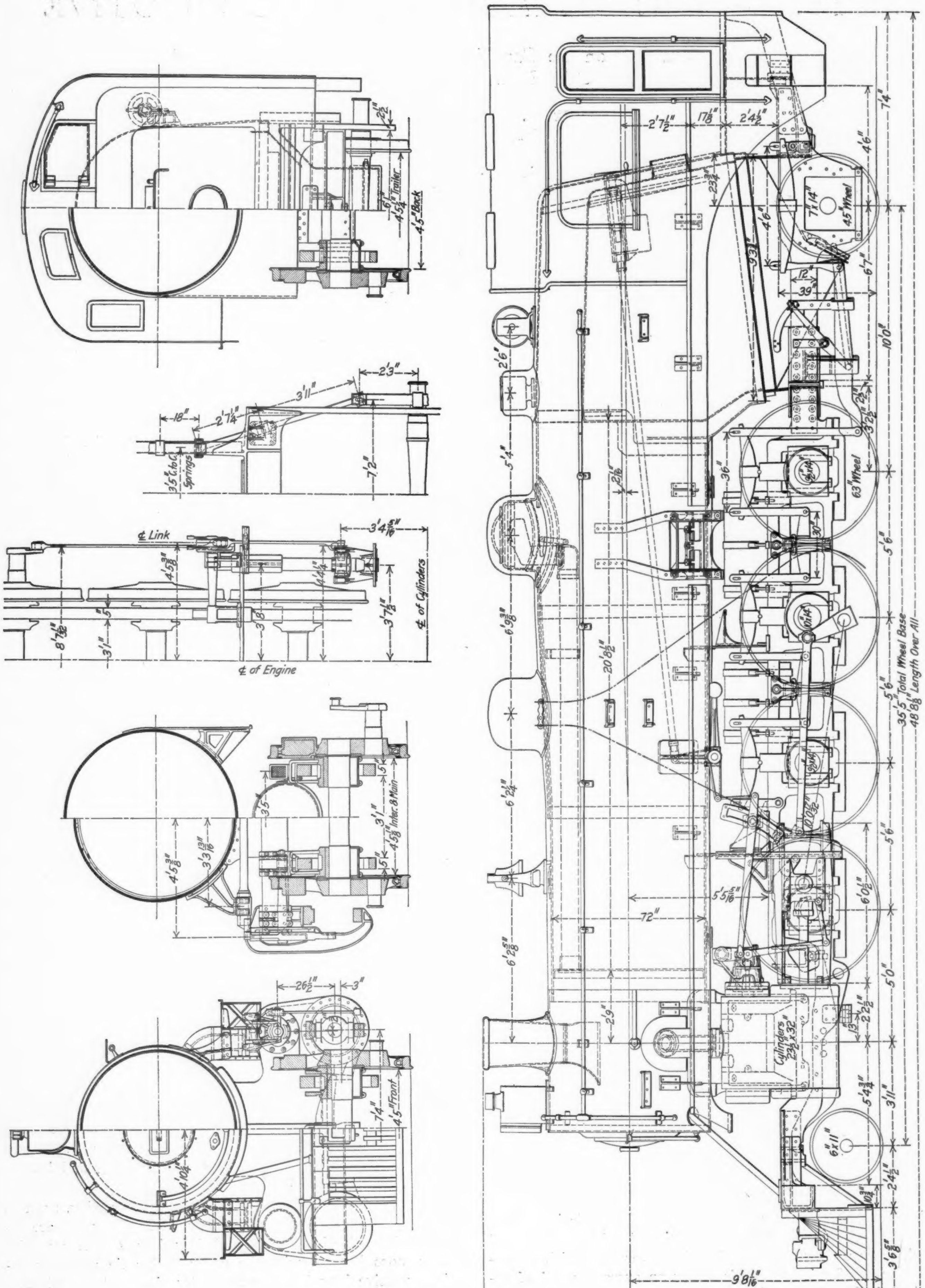
With this arrangement there is no truck center pin. The front end of the main equalizer rests on the top of a casting called the upper wedge tie, or bolster. This casting is guided in its vertical movement by the front foot plate into which it extends. To this upper wedge tie a pair of double faced wedges is bolted, which in turn rest on a similar bottom pair bolted to the truck frame casting. The wedges themselves are so designed that, regardless of the movement of the truck, a set of faces on each pair of top and bottom wedges is always in contact.

The truck frame is a single steel casting. To this frame the pedestals and radius bars are bolted. It carries the bottom wedges, with their centers 18 in. apart. These wedges are each placed between shoulders ¼ in. high, and in addition are held in place by four bolts of one inch diameter with countersunk heads.

The wedges are placed at an angle of approximately 23 deg. with the longitudinal center line of the truck frame. This position allows the longitudinal center lines of the wedges to approximate the arc of a circle whose radius is the distance from the center of the engine truck radius bar pin to the center of the wedges. When the locomotive is rounding a curve this permits of continuous contact between the top and bottom wedges under all conditions.

Integral with the bottom wedge tie, or frame casting, are two stops. These are reinforced by heavy ribs. The stops are located at the back of the frame and their duty is to engage with similar stops integral with the upper wedge tie and thus restrict excessive lateral movement under abnormal conditions.

The upper wedge tie is also a well ribbed steel casting to which the top wedges are fastened in the same manner as to the

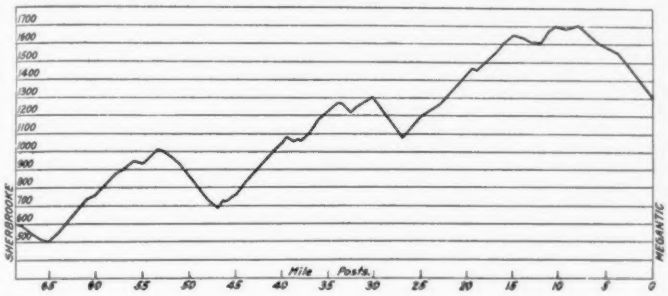


General Arrangement of the Canadian Pacific Mikado

frame casting. This upper tie extends up and into the front foot plate of the engine and is guided thereby.

The tie, rectangular in shape, has a ½ in. brass liner riveted at each end. These brass liners are 13½ in. long by 7 in. wide, and take the frictional load between the tie and similar liners bolted to the inner sides of the front foot plate.

The foot plate liners are held in place by a number of the bolts used to hold the front foot plate between the frames. The heads of the bolts in this case are flattened and countersunk.

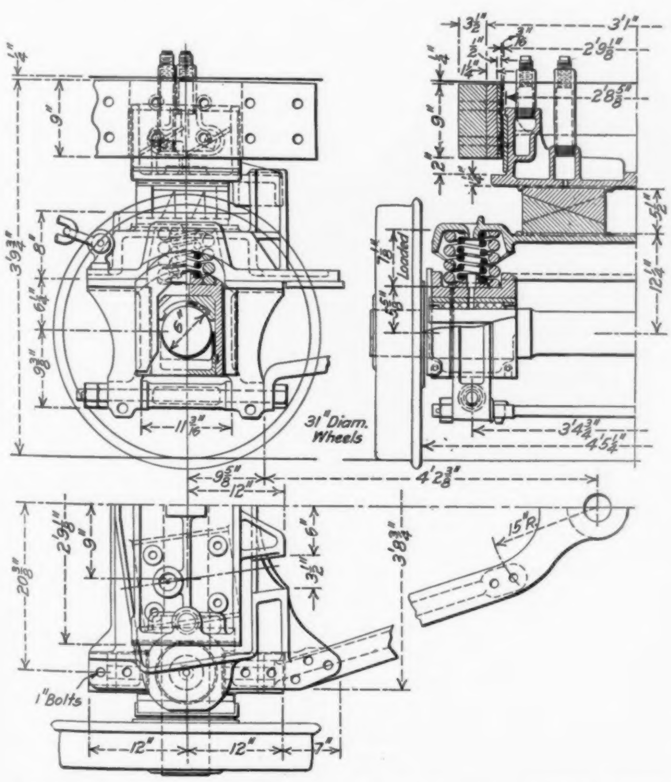


Profile of the Canadian Pacific Between Sherbrooke and Megantic

With this arrangement any lateral play that may develop can easily be taken up.

A number of hard grease cups, or receptacles, are cast integral with the upper wedge tie. At each end of the tie one of these receptacles is so located that holes drilled through the end wall form a passageway from the grease cavity to suitable openings through the brass liners. These openings in the liners are 1½ in. square, and form a pocket or reservoir, from which radiating grease grooves are cut.

Two other grease cavities are so cast and holes so drilled



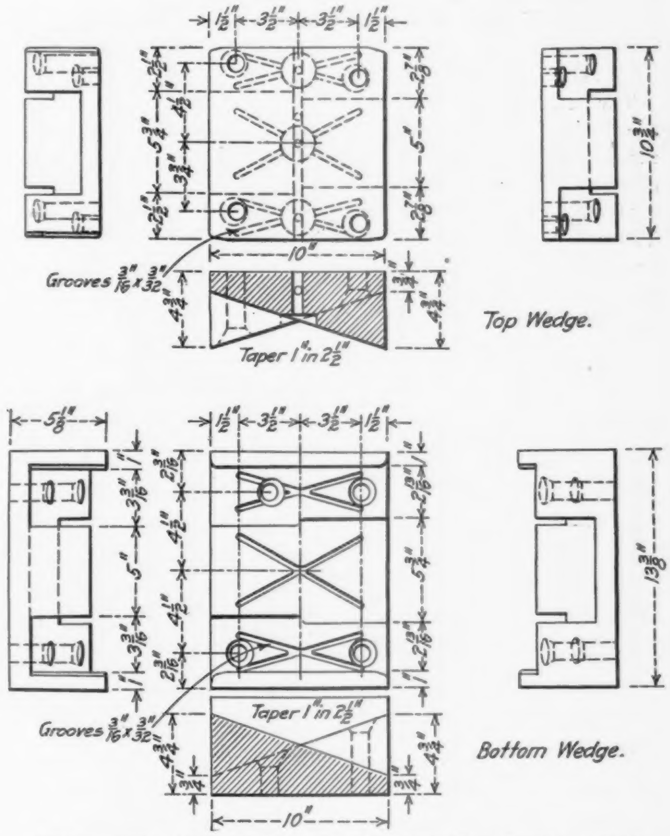
Arrangement of the Engine Truck of the Canadian Pacific Mikado

that grease can be forced from them to passages in the body of the upper wedges, these passages terminating at the wedge bearing faces. With this arrangement grease can be forced down and out betwen the friction faces of the wedges.

In both cases the cavities are tapped out and have screwed in them cast iron extensions which pass through suitable holes in the foot plate. Ordinary grease plugs are screwed in these extensions, enabling both the liners and wedges to be lubricated from the top and outside of the front foot plate.

Inspection of the illustration will show that each individual wedge possesses three distinct wearing faces. The two smaller, or outer faces, lie in the same plane and are inclined in one direction. The center face is inclined in the opposite direction. These faces are all inclined in their respective planes at an angle of approximately 22 deg. The sum of the areas of the two outer faces is equal to the area of the center face. With the top wedges in the central position, and superimposed on the bottom ones, all the frictional faces of the wedges are in contact.

Another interesting feature is the combined back steam chest cover and valve stem crosshead guide. The general arrangement of this device can best be noted from inspection of the accompanying photograph. It will be seen that the back steam chest cover, the valve stem crosshead guides, and the support for the rocker arm, through which the motion is transmitted to



Engine Truck Wedges Used on the Canadian Pacific Mikado

the valve stem, are combined in one casting. This is a cast iron structure adequately ribbed and well proportioned. This casting supports a double armed rocker, whose arms extend downward.

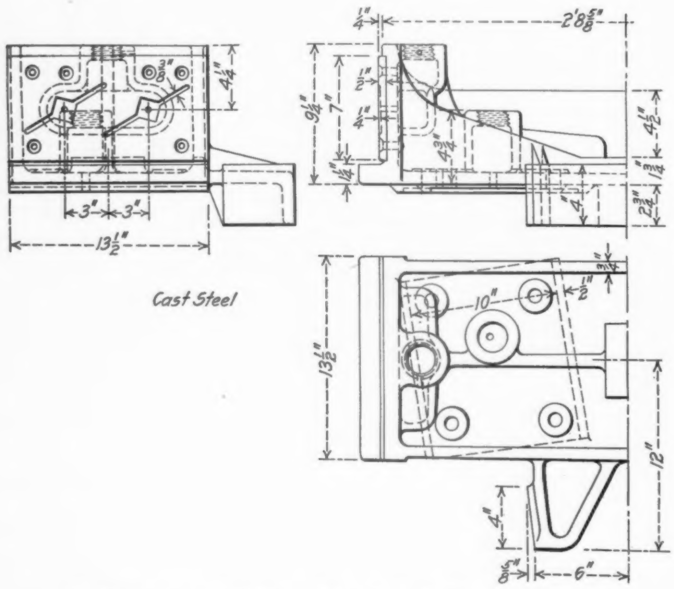
The valve stem crosshead block is held by a 1 13/16 in. pin passing through the extremities of these arms. The weight of the combination lever and radius rod is carried on an extension of this pin, which is 2¼ in. in diameter at the point where it passes through the combination lever. The rocker arm is likewise a single casting supported by two journals 3 1/64 in. in length and 4 in. in diameter. The use of the large journals and large motion pins tends to minimize the wear.

The chief object of this construction has been to provide a rigid support for the valve stem guide. The device not only accomplishes this purpose, but relieves the valve stem from any downward thrust due to the movement and weight of the parts of the valve gear to which it is connected. Should any excessive wear develop in the pins or guides, the result is the same. With some modifications this arrangement is similar to the one

described in detail in the American Engineer and Railroad Journal, January, 1908, about which time the device had its inception. Since that time it has been so economical to maintain, and has proved its merit so conclusively that it has come into general use on the Canadian Pacific.

These locomotives are all equipped with the vestibule cab which completely encloses the deck space between the engine and tender, and protects the enginemen from the intense cold that prevails at times. These cabs are the same as those previously described in these columns (March, 1913, page 117) with the exception that the front doors have been eliminated and windows substituted. The front cab doors became an obsolete passage way with the advent of the extended running boards and the extended handrails above the side windows. The runboards extend 3 in. from the outside of the cab below the side windows. In conjunction with the handrail above the side windows, they make the front runboards easier of access than through the previously existing front doors, which could only be reached through a narrow passageway partially obstructed by piping. That the vestibule cab has proved its merit is evinced by the fact that at the present time 207 Canadian Pacific locomotives are so equipped.

The tenders are the type in which the underframe and tank are an integral and self supporting structure. The general features of this design were also described in the article mentioned above. This type has proved so economical and so easy of fabrication that it has been made standard on the Canadian Pacific. The coal space has a capacity of 16 tons, and all of these tenders are equipped with air actuated coal pushers of the hinged type. A very large percentage of all the engines on this road have tenders equipped with this type of pusher. The tanks have



Engine Truck Bolster Guide, Canadian Pacific Mikado

a capacity of 7,000 Imperial gallons, equivalent to approximately 8,500 U. S. gallons.

These engines are all equipped with the Vaughan-Horsey superheater. They are also equipped with screw reverse gear and Westinghouse 8½ in. cross compound pumps.

The general dimensions, weights and ratios are as follows:

General Data

Gage	4 ft. 8½ in.
Service	Freight and passenger
Fuel	Bituminous coal
Tractive effort	42,000 lb.
Weight in working order	258,000 lb.
Weight on drivers	198,000 lb.
Weight on leading truck	25,000 lb.
Weight on trailing truck	35,000 lb.
Weight of engine and tender in working order	428,000 lb.
Wheel base, driving	16 ft. 6 in.
Wheel base, total engine	35 ft. 5 in.
Wheel base, engine and tender	66 ft. 5 in.

Ratios

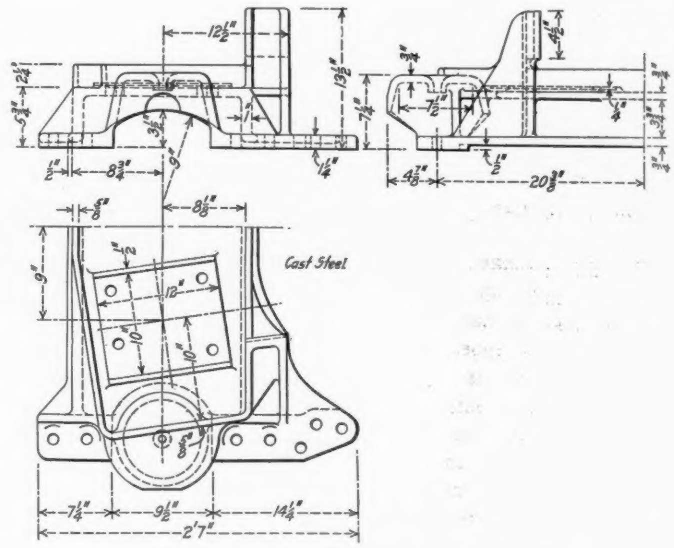
Weight on drivers ÷ tractive effort	4.70
Total weight ÷ tractive effort	61.50
Tractive effort × diam. drivers ÷ heating surface*	560.00
Total equivalent heating surface* ÷ grate area	94.70
Firebox heating surface ÷ total equivalent heating surface, per cent.	3.97
Weight on drivers ÷ total equivalent heating surface	41.80
Total weight ÷ total heating surface*	54.50
Total heating surface* ÷ volume of cylinders	294.00
Grate area ÷ volume of cylinders	3.11

Cylinders

Kind	Simple
Diameter and stroke	23½ in. x 32 in.

Valves

Kind	Piston
Diameter	12 in.



Engine Truck Frame, Canadian Pacific Mikado

Greatest travel	6 in.
Lap	1 in.
Inside clearance	Line and line
Lead	¼ in.
Type of valve gear	Walschaert

Wheels

Driving, diameter over tires	63 in.
Driving, thickness of tire	3½ in.
Journals, main, diameter and length	10 in. x 14 in.
Journals, others, diameter and length	9½ in. x 14 in.
Engine truck wheels, diameter	31 in.
Engine truck journals	6 in. x 11 in.
Trailing truck wheels, diameter	45 in.
Trailing truck journals	7 in. x 14 in.

Boiler

Style	Extended wagon top
Working pressure	180 lb.
Outside diameter first ring	72 in.
Outside diameter dome course	79 in.
Firebox, length and width, inside	8 ft. 7¼ in. x 5 ft. 9⅞ in.
Firebox plates, thickness	½ in., 5/16 in. and ⅜ in.
Firebox water space	Front, 5 in.; Sides, 4½ in.; Back, 3½ in.
Tubes, number and diameter	210—2¼ in.
Flues, number and diameter	30—5¼ in.
Tubes, thickness	No. 11 B. W. G.
Flues, thickness	No. 8 B. W. G.
Length over tube sheets	20 ft. 8½ in.
Heating surface, tubes	3,410 sq. ft.
Heating surface, firebox	188 sq. ft.
Total fire heating surface	3,598 sq. ft.
Superheating surface	760 sq. ft.
Total equivalent heating surface	4,738 sq. ft.
Grate area	50 sq. ft.
Superheater, kind	Vaughan-Horsey
Center of boiler above rail	116 1/16 in.

Tender

Wheels, diameter	36¼ in.
Journals, diameter and length	6 in. x 11 in.
Water capacity	7,000 Imperial gal.
Coal capacity	16 tons

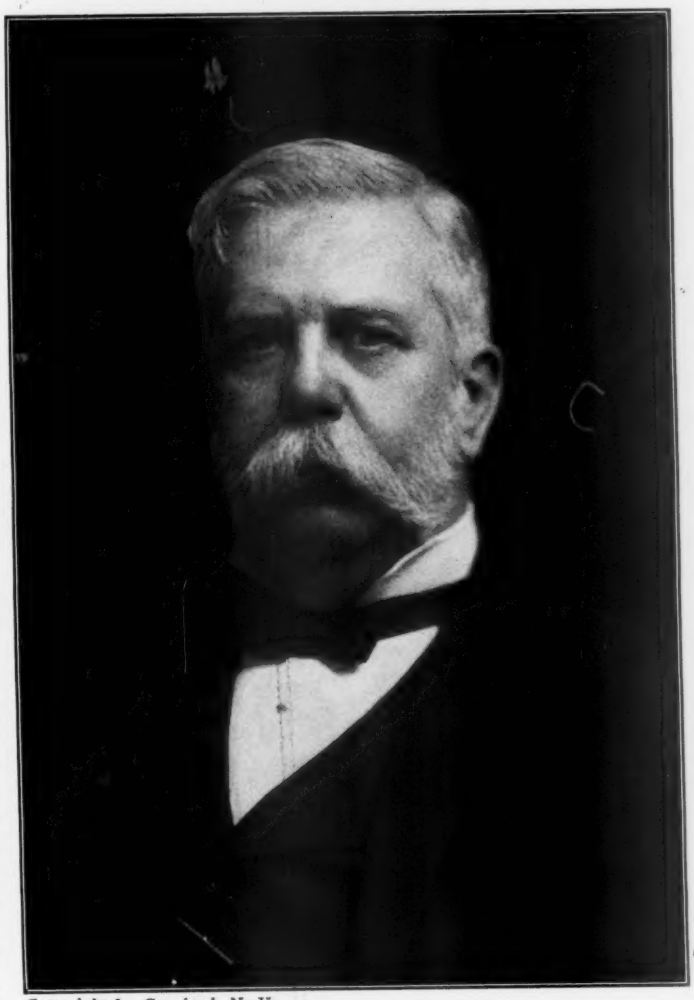
*Total equivalent heating surface.

Record Loading of a Steamer.—What is surely a record for speedy loading is that held by the Great Lakes steamship William E. Corey, which, at Two Harbors, Minnessota, took 10,100 tons of iron ore into her hold in 28 minutes. The Corey is of the hopper bottom type.—*Scientific American.*

CAREER OF GEORGE WESTINGHOUSE

The World Loses in Him a Great Engineer, a Distinguished Scientist and an Exemplary Citizen

George Westinghouse, inventor of the air brake for railroad trains, inventor and developer in many other mechanical and electrical fields, philanthropist, and one of the chief citizens of the United States, died at his apartments in New York City, March 12, of heart disease, having been confined to his room for about three months; previous to which time he had been for some months at his country house in Lenox, Mass. The fatal malady began to show itself over a year ago, and he had gradually withdrawn from all business activities. He is survived by his wife and by one son, George W., Jr., a graduate of Yale and recently married. The body was buried at Woodlawn Cemetery, New York City.



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George Westinghouse

The will of Mr. Westinghouse provides for the continuation of his large business interests under a trusteeship, and his death will bring no change in the administration of any of the numerous important concerns of which he had been the leader.

The great and outstanding invention of Mr. Westinghouse is the air brake. By this his name was carried all over America before he was 25 years old, and all over the world before he was 35. His later inventions are less known because they are less easily comprehensible and because the world is now so full of other wonders; but the benefits which they confer on mankind are immeasurable. In his intense and catholic devotion to the genuine progress of civilization, as distinguished from mere personal glory or aggrandizement, Mr. Westinghouse was as much of a developer as an inventor; as truly enthusiastic in carrying out others' ideas as his own; and his notable contributions to general progress include electric lamps; long distance electric power transmission, made possible only by means of his development of the alternating current; the steam turbine; the friction draft gear and the wide utilization of natural gas.

A survey of Mr. Westinghouse's activities in these several fields, beginning back in the later seventies, as soon as the complete success of the air brake was assured, makes clear the unique and outstanding genius of the man; namely, the sanity and vigor with which constantly, year after year, he devoted his brilliant talents and his unbounded energies always in the most useful channels available. As the small or weak man seeks constantly the line of least resistance, this giant constantly took the opposite course. He aimed to throw the whole force of his own ability, the talents of his assistants and the facilities of his great shops and laboratories into that line where the world most needed those abilities, talents and facilities. And, though he was not free from mistakes, his mind was so active and fertile, his perceptions so wise, that he kept in the front rank of progress throughout the 40 years of his active career. Unlike many mechanical geniuses, he was large hearted and human; a philanthropist who elevated the lives of his workmen. The verdict of history will recognize the unique combination; a mechanic possessed of genius, a versatile scientist and thinker of the first rank, and a humane "business man." Not the smallest element in the success with which he carried out his purposes in these diverse lines was the loyal co-operation of his brother, Henry Herman Westinghouse, and of other lifelong coadjutors, whom he selected with unusual insight and rewarded with liberality.

George Westinghouse was born in the village of Central Bridge, New York, October 6, 1846. His father, George Westinghouse, who came from Vermont, was of German descent, and his mother's ancestors were Dutch-English. The elder Westinghouse established in Schenectady, in 1856, the Schenectady Agricultural Works; and in the father's shops the boy spent much of his leisure time. Before he was 15 he invented and made a rotary engine and at an early age passed the examination for the position of assistant engineer in the United States Navy. He served in the army in the Civil War, first in the 12th New York National Guard and later as third assistant engineer in the navy. At the close of the war, resisting solicitations to remain in the navy, he entered Union College, Schenectady, but at the end of his sophomore year he abandoned his classical studies and entered on his active life. It is said that the president of the college in substance advised him to take that course, predicting that in the course of time he would become a great engineer. Indeed, even before this, in 1865, he had made his first railroad invention, a cast steel re-railing frog.

THE AIR BRAKE

The air brake, like the re-railing frog, was suggested by actual necessity as shown by a train accident, in 1866. Westinghouse first thought of a brake attached to the car couplers, but this, when tried, proved impracticable. Next he tried steam, which was not a success. At this point, Fate seems to have entered his life. In the pages of a magazine to which he had subscribed through the solicitation of a young woman, he saw an account of the use of compressed air in drilling the Mont Cenis tunnel; and instantly the inventor saw the light. After much reflection, drawings of the air-pump, brake cylinder and valves were made, and a caveat was filed in 1867; but it was not for a considerable time

after this that he was able to make a trial of the brake. He moved to Pittsburgh; and there he finally secured the aid of Ralph Baggaley, who guaranteed the payment of the foundry bill for the first apparatus. This was in 1868. The brake was tried on the Steubenville accommodation train of the Pittsburgh, Cincinnati & St. Louis. It received its initial trial unexpectedly on its very first run. The engineman, seeing a wagon stuck on a crossing not very far ahead, applied the air. Like everybody else, he was not free from skepticism; but the brake averted an accident and its popularity was thenceforth assured.

The first patent was issued April 13, 1869. The Westinghouse Air Brake Company was formed on the 20th of July, following. The first shop was established with 20 workmen. In the autumn of 1869 a demonstration was made on the Altoona grade for the Master Mechanics' Association, in connection with the annual meeting of the association.

The success of the brake—which was the "straight air"—on the Pittsburgh, Cincinnati & St. Louis, led a number of other roads to make applications and soon it was known throughout the country. There had been experiments with chain brakes before, and considerable sums had been spent on coil spring arrangements and other notions, but the compressed air brake was the first device of the kind that had a lasting success. The slight competition of the vacuum brake had but a brief influence.

In 1870, Mr. Westinghouse went to London to introduce the air brake on the English roads. This was a difficult problem, as the usual practice in Europe was to have no brakes at all, not even hand brakes, except on the brake vans and tenders. This enterprise required the spending of seven years in Europe between the years 1871 and 1882. It taxed the inventor's ability to meet conditions; but he introduced the brake on passenger trains on a number of prominent roads.

But the greatest triumph was the advent of the automatic brake in 1872-73. The original or straight air system was dependent on the integrity of the car couplings. With the "automatic" and its wonderful triple valve, the line of pipe through the train was normally filled with air at 70 lb. pressure and the *release* of this pressure caused the application of the brakes; and of course the breakage of a car coupling, causing the parting of a train, applied the brakes and stopped the separated parts.

And this invention of the triple valve, to meet the first great obstacle encountered in the pursuit of a perfect braking system, was only the beginning of a series of inventions which solved the difficulties incident to the successive enormous increases in weight, length and speed of trains. If a new problem, or series of problems, demanded the inventor's application for 17 hours a day for successive months, or if elaborate and complicated details called for the work of a dozen of the most expert specialists simultaneously, the resources of the Westinghouse establishment were devoted to the task and it was accomplished.

In 1886-87 the "quick action" brake was brought out. The air brake had at first been introduced only on passenger trains. On the mountain railroads of the West, its value was soon demonstrated on freight trains also; and from these roads it spread slowly to the other parts of the country, so it came about that the inventor was confronted with an entirely new problem, that of braking very long trains. But with a fifty-car train, the cars in the front portion were stopped much sooner than those in the rear portion, so that when the slack ran in, there was a small collision—or perhaps a serious smash-up. The elaborate three-weeks' trials on the Burlington road near Burlington, Iowa, in 1886, under the direction of the Rhodes Committee, form a prominent page in American railroad history. At the completion of these trials the conclusion was quite general that electricity would afford the only possible means of controlling power brakes on long trains; but Mr. Westinghouse determined, if possible, to adapt the air brake to the new conditions; and he triumphed. If the original triple valve was an epoch-making invention, this modification of it was only second in importance.

The triple valve had reduced the time for the application of the brakes on the whole of a ten-car train, as compared with the straight air, from 25 seconds to 8 seconds; and now the power was made to act throughout a train of 50 cars in 2 to 3 seconds. It was in October and November, 1887, that the exhibit train of 50 freight cars made its triumphal tour of the United States. Railroad men were amazed when they saw a loaded freight train, 1,700 feet long, running at 40 miles an hour, brought to a stop in less than 600 feet. In 1869-70, the wonder had been in seeing a train stopped apparently by an unseen power; in 1887, the wonder took the shape of a striking display of power. As compared with former performances, the stoppage of a train by the new apparatus appeared to be a manifestation of energy on an incredible scale.

HONORS

His many achievements in mechanics, electricity, steam and gas brought Mr. Westinghouse honorable distinctions from all parts of the world. His alma mater, Union College, conferred upon him the degree of doctor of philosophy. He was decorated with the order of the Legion of Honor, with the order of the Royal Crown of Italy, and with the order of Leopold of Belgium. He was the second recipient of the John Fritz medal. He received the degree of doctor of engineering from the Koenigliche Technische Hochschule of Berlin. He was an honorary member of the American Society of Mechanical Engineers, of which body he was president in 1910. The archives of that company contain the authentic history of the air brake. He was awarded the Scott premium and medal by the Franklin Institute of Pennsylvania, and received the Edison gold medal for meritorious achievements in the alternating current system of electrical distribution. He received the Grashof gold metal from the Society of German Engineers in Germany, which acknowledged him the greatest American engineer.

A partial list of the industries in which he was an officer or leader includes the Westinghouse Air Brake Company; the Westinghouse Machine Company; the Nernst Lamp Company; The Union Switch & Signal Company; the Societe Anonyme Westinghouse, Paris; the Cooper Hewitt Electric Company; the Societe Italiane Westinghouse, Italy; The East Pittsburgh Improvement Company; the Westinghouse Brake Company, Limited, of London; Westinghouse Cooper Hewitt Company, London; the Westinghouse Friction Draft Gear Company, and the Westinghouse Metal Filament Lamp Company, Limited, London. He was also chairman of the board of directors of Westinghouse Electric Company, Limited, London, and a director in the Westinghouse Metallfaden Gluhlampenfabrik, Vienna.

The Westinghouse companies altogether employ 50,000 men and the total capitalization of all the companies is $200,000,000.

PERSONAL CHARACTERISTICS

Mr. Westinghouse's biographer will have to devote one of his largest chapters to the man's personality, from what might be called the non-technical side. His kind heart was a worthy complement of his phenomenal mind. It is recorded that in his first shop, started in 1869, he introduced the fifty-four-hour week and the Saturday half-holiday, at that time new things in America. Of the Employees' Association at the air brake village he was not only a member, but a regular attendant. He was a pioneer in providing model dwellings for the employees of the shops on a large scale, and at reasonable prices. Young inventors whom he aided spoke of him not only as a wise and powerful supporter, but as a sympathetic friend.

He was a man of great physical strength, six feet tall, and lived an abstemious and sober life; never smoked, and ate and drank sparingly. Change of work constituted his principal diversion; he was too modest and serious to care much for "society."

It was these qualities which enabled him, in the strenuous contests with rival inventors and contractors which attended his electrical enterprises, to accomplish mental tasks which to the ordinary mind are incomprehensible in their magnitude.

COMPOUND LOCOMOTIVES

The Railway Gazette, London, England, prints the following from a correspondent on the subject of compound locomotives:

The fact that compound engines can be made to develop much greater power than the simple engine when each uses the same weight of steam will no doubt have caused considerable surprise to the uninitiated as to why the compound locomotive failed to fulfill its promise and why a certain railway converted all its compounds back to simple. Yet the explanation is very simple.

In the first place, it must be borne in mind that the tractive effort of a locomotive must never exceed its adhesive weight. Now it must be obvious that if two engines are designed to develop the same tractive effort it becomes impracticable with existing designing of locomotives to make the compound engine more powerful than the simple engine. The very fact of restricting the power of the former thus defeats the object of compounding; curiously enough there is a very simple way out of the difficulty. For instance, the tractive effort of a locomotive is based on its maximum starting effort when the lever is in full gear, a condition under which it is never called on to do regular duty. It is therefore only necessary to base the tractive effort with a cut off in the high pressure cylinders, and where enginemen usually work—somewhere about 30 per cent of the stroke of the piston—to effect an important improvement in favor compounding, for it at once becomes impracticable to design a simple engine which can compete with it.

If locomotive designers are going to take up the question of compounding seriously, let them combine and have one experimental engine made which will be the counterpart of one of the best types of simple engines now at work, viz., one with 19 in. by 26 in. cylinders; let the equivalent of two cylinders 30 in. in diameter be placed between the frames. They will then have a compound which can be worked in every respect similar to a simple engine, both as regards starting a train and in linking up to an early cut off in the high pressure cylinders; it will, moreover, in every case, and under all conditions, deal with a load in every respect similar to a simple engine, even to making use of steam heated up to the highest temperature practicable.

It may be objected that a compound engine with two 19 in. high pressure and two 30 in. low pressure cylinders would give a tractive effort far in excess of the adhesive weight when the high pressure valve gear was full over. If, however, the engineman cannot be trusted to place the lever at 30 per cent cut off soon after the engine moves, it is only necessary to have notches in the quadrant for a 30 per cent cut off. A small cylinder can be connected to the reversing arm and connected to the low pressure receiver, so that while the latter was being charged with steam from the exhaust of the high pressure it would act on the piston and place the high pressure lever at 30 per cent so that the engineman could never work with a later cut off.

The maximum power of the simple engine would be when working with a 75 per cent cut off in the cylinders, and the maximum power of the compound when working with a 30 per cent cut off in the high pressure cylinders.

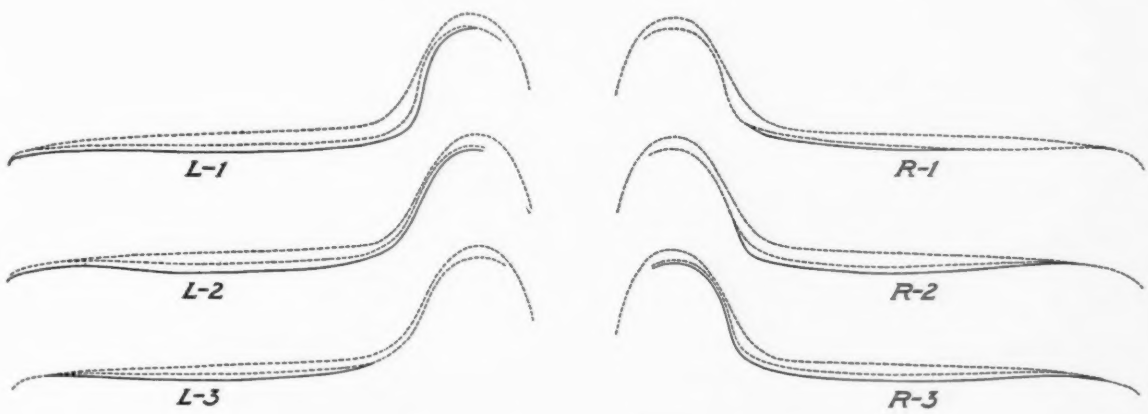
It would, of course, be open to locomotive designers to produce a simple engine which would have a tractive effort equal to the adhesive weight of the engine when working with a 30 per cent cut off by using four large cylinders.

SERVICE OF VANADIUM STEEL TIRES

The Western Maryland applied a set of heat-treated chrome-vanadium steel tires to a Pacific type locomotive in April of last year. Contours were taken this month, after 11 months' service, and comparison between the performance and the average for three sets of plain carbon steel tires on sister engines running in the same district show an increase of 148 per cent in mileage per 1/16 in. maximum tread wear in favor of the vanadium steel tires.

Up to March 1, the vanadium steel tires had made 49,096 miles. The maximum tread wear was 3/16 in., or 16,365 miles per 1/16 in. maximum wear. The three engines equipped with carbon steel tires showed respectively 5,393, 6,140 and 7,250 miles per 1/16 in. maximum tread wear, or an average of 6,594 miles per unit of maximum wear.

The service of the vanadium steel tires is shown by the accompanying illustration. This shows the present contours and contours taken in October after six months' service superimposed on each other and also on the original contour to which the tires were rolled. The full line represents the present contour and the middle dotted line the contour taken in October of last year. The flange wear is somewhat greater on the right than on the left tires. The tread wear, though quite uniform, shows if anything a little less wear in proportion during the last five months of service than during the first six months.



Contours of Western Maryland Vanadium Steel Tires

The Pacific type locomotive to which these tires are applied has a total weight in working order of 188,800 lb., with 122,600 lb. on drivers, or an average of 20,430 lb. per wheel. The rigid wheel base is 11 ft. 10 in., and the total engine wheel base 30 ft. 4½ in. The tires are 62 in. inside diameter and 3 in. thick. The chemical composition and physical properties were as follows:

Chemical Composition

Carbon	0.55 per cent
Manganese	0.74 per cent
Chromium	0.89 per cent
Silicon	0.35 per cent
Vanadium	0.28 per cent
Phosphorus	0.039 per cent
Sulphur	0.025 per cent

Physical Properties (After Heat-Treatment.)

Elastic limit, lb. per sq. in.	111,000
Tensile strength, lb. per sq. in.	153,500
Elongation in 2 in., per cent	13.5
Reduction of area, per cent	42.5

TYPICAL EXAMPLES OF RECENT PASSENGER LOCOMOTIVES

ARRANGED IN ORDER OF TOTAL WEIGHT

ATLANTIC, TEN-WHEEL, MOGUL AND SWITCHING TYPES

Type	4-4-2	4-4-2	4-4-2	4-4-2	4-4-2	4-6-0	4-6-0	4-6-0	4-6-0	2-6-0	2-6-0	0-10-0	0-8-0	0-8-0	0-8-0	0-8-0	0-6-0	0-6-0
Name of road	P. R. R.	C.R.I.&P.	Sou.Pac.	Mo. Pac.	P. & R.	Sou.Pac.	St.L.S.	D. & H.	Can.Nor.	Vandalia	D.L.&W.	N.Y.C.	D.L.&W.	C.N.Eng.	C.&W.I.	A.C.&I.	I. C.	Southern
Road number or class	E 6s	W-28	3048	5531	100	2368	659	D3b	280	158	545	M4	185	109	105	13	218	1728
Builder	P. R. R.	Amer.	Baldwin	Amer.	P. & R.	Amer.	Baldwin	Amer.	Amer.	Amer.	Amer.	Amer.	Amer.	Amer.	Lima	Baldwin	Amer.	Lima
When built	1913	1910	1911	1912	1913	1913	1913	1912	1911	1907	1909	1907	1910	1913	1911	1910	1913	....
Tractive effort, lb.	29,427	29,600	23,500	24,990	21,700	36,500	33,400	31,500	28,900	33,300	29,480	55,360	53,800	45,200	43,290	41,200	32,450	32,000
Weight, total, lb.	240,000	202,000	196,000	191,000	161,500	222,000	209,200	199,000	173,000	187,000	171,500	274,000	229,000	202,500	201,000	165,000	166,000	145,500
Weight on drivers, lb.	133,100	116,000	105,000	115,000	98,375	173,500	164,680	147,500	133,000	159,000	150,500	274,000	229,000	202,500	201,000	165,000	166,000	145,500
Weight on truck, lb.	55,000	49,000	45,000	42,000	26,775	48,500	44,520	51,500	40,000	27,700	21,000	....	....	....	....	....	....	....
Weight on trailer, lb.	51,900	37,000	46,000	34,000	36,350	....	....	....	....	....	....	....	....	....	....	....	....	....
Weight on tender, loaded, lb.	158,000	149,900	159,000	146,500	138,000	140,400	171,800	145,500	123,650	146,000	129,300	151,700	134,000	119,500	141,500	100,000	100,400	93,300
Wheel base, driving, ft. & in.	7—5	7—0	7—0	7—6	6—6	13—10	15—0	15—0	14—6	14—9	15—0	19—0	16—0	15—0	15—6	15—4	11—8	11—0
Wheel base, total engine, ft. & in.	29—7½	30—10	27—7	29—8	24—7½	25—10	26—2	26—9	24—10	23—10	23—10	19—0	16—0	15—0	15—6	15—4	11—8	11—0
Wheel base, engine and tender, ft. & in.	63—10½	62—8	58—2	59—⅞	53—5½	58—3/16	61—5¼	58—0½	54—3	56—10¼	52—7½	54—7½	49—2¾	47—8¼	51—4	45—7½	42—11⅜	43—4¾
Diameter of drivers, in.	80	73	81	78	68½	69	69	63	63	63	63	52	57	51	57	51	51	51
Cylinders, number	2	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Cylinders, diameter, in.	23½	17½	20	21	18	23	22	23	22	21	20½	24	27	22	24	21	21	20
Cylinders, stroke, in.	26	26	28	28	24	28	28	26	26	28	26	28	30	28	28	28	26	26
Valve gear, type	Wals.	Wals.	Steph.	Steph.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Steph.	Wals.	Steph.	Steph.	Wals.	Steph.
Steam pressure, lb.	205	160	200	200	225	200	200	170	170	200	200	210	165	200	180	200	180	185
Boiler, type	Belpaire	E. W. T.	Straight	....	Wootten	E. W. T.	W. T.	E. W. T.	Conical	Straight	Straight	Conical	Straight	......	E. W. T.	Straight	......	E. W. T.
Boiler, smallest diameter, in.	78½	68⅛	70	68	46	72	72	66¼	66	77	66	80 1/16	83½	74⅜	74⅜	68	63	63
Tubes, number and diameter in inches	242—2	206—2	297—2	362—2	180—1¾	204—2	212—2	206—2	185—2	390—2	310—2	446—2	450—2	402—2	327—2¼	276—2	151—2	302—2
Flues, number and diameter in inches	36—5⅜	24—5¼	......	......	......	28—5⅜	30—5⅜	28—5⅜	26—5⅜	.....	.....	.....	......	......	......	......	19—5½	......
Length of tubes and flues, ft. & in.	15—0	18—0	16—0	16—⅛	14	15—0	15—0	14—6	13—2¼	13—7	13—6	19—0	15—0	15—0	14—9½	16—0	13—4	15—1½
Heating surface, tubes and flues, sq. ft.	2,660.5	2,521.0	2,475.0	3,012.0	1,154	2,181	2,285	2,120.0	1,746.0	2,754.6	2,176	4,416.0	3,514.7	3,139	2,832.1	2,300	1,409	2,376
Heating surface, firebox, sq. ft.	195.7	194.5	179.8	182.5	120	219	173	150.7	183.0	180.4	161	186.2	194.6	171	165.9	139	150.5	110
Heating surface, total, sq. ft.	2,856.2	2,715.5	1,654.8	3,194.5	1,274	2,400	2,458	2,270.7	1,929.0	2,935.0	2,337	4,602.2	3,709.3	3,332	2,998.0	2,439	1,559.5	2,486
Heating surface, superheater, sq. ft.	721	479.0	....	....	.....	475	532	461.0	403.2	....	.....	....	....	.....	....	.....	266.6	.....
Grate area, sq. ft.	55.13	42.8	49.5	44.5	63	32.1	49.6	50.2	31.6	52	53.4	55	58.1	47.5	41.2	44	38.8	29
Firebox, length, in.	110½	102 3/16	108	96.0	108	124	102	96	113⅛	108	102	108⅛	111⅛	96	108	96⅛	109⅝	65⅛
Firebox, width, in.	72	60⅜	66	67.0	84	37½	70	75¼	40¼	69	75	73¼	75¼	71¼	60¼	66	78	65¼
Kind of fuel	Bit. coal	Bit. coal	Oil	Bit. coal	An. coal	Oil	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal
Tender, coal capacity, tons	13	13	2,835 g.	14	9.75	2,940 g.	15	14	10	13	10	12	10	10	11	11	6½	7
Tender, water capacity, gal.	7,000	7,500	9,000	7,000	6,000	7,000	9,000	6,800	6,000	7,500	6,500	8,000	7,000	6,000	7,400	5,000	5,500	4,500
Weight on drivers ÷ tractive effort	4.52	3.29	4.47	4.6	5.13	4.75	4.94	4.68	4.6	4.76	5.1	4.45	4.28	4.49	4.64	4.00	5.11	4.54
Weight on drivers ÷ total weight, per cent.	55.70	57.50	53.70	60.20	61.50	78.00	79.00	73.80	78.60	85.00	88.00	.....	.....	.....	.....	.....	.....	.....
Evap. heat. surf. ÷ superheater heat. surf.	3.97	5.68	....	....	....	5.08	4.60	4.92	4.79	.....	.....	.....	.....	.....	.....	.....	5.85	.....
Firebox heat. surf. ÷ total heat. surf., per ct.	4.93	7.18	6.75	5.72	10.61	9.15	7.03	6.67	9.50	6.13	6.80	4.03	5.24	5.12	5.52	5.71	9.60	4.42
Firebox heat. surf. ÷ grate area	3.55	4.54	3.63	4.10	1.91	....	3.50	3.00	5.80	3.48	3.02	3.40	3.36	3.60	4.03	3.16	3.86	3.80
Total heat. surf. ÷ grate area	71.30	63.40	53.80	71.80	20.22	....	49.50	45.00	61.00	56.50	43.60	84.00	63.80	70.10	72.70	55.20	40.20	86.00
Tractive effort × diam. drivers ÷ heat. surf.	509.00	798.00	717.00	609.00	1,032.00	1,045.00	937.00	875.00	945.00	717.00	795.00	625.00	825.00	691.00	823.00	863.00	1,058.00	655.00
Total weight ÷ total heat. surf.	61.00	74.50	73.80	59.70	126.70	92.70	85.00	88.00	89.50	63.80	73.50	59.50	61.80	60.80	67.00	67.50	106.00	58.50
Volume of cylinders, cu. ft.	13.10	14.43	10.15	11.20	7.06	13.30	12.20	12.45	11.40	11.20	9.95	14.66	19.90	12.20	14.66	11.20	10.37	9.50
Total heat. surf. ÷ cylinder volume	300.00	188.00	262.00	285.00	180.00	181.00	204.00	182.00	169.00	262.00	234.00	314.00	186.50	272.00	204.00	218.00	150.50	262.00
Grate area ÷ cylinder volume	4.21	2.97	4.92	3.98	8.92	....	4.00	4.03	2.77	4.65	5.38	3.75	2.93	3.89	2.81	3.93	3.75	3.04
Reference for photograph, drawings or description	Am.Engr. 1914-p69	*Loc. Dic. 1912-p180	Loc. Dic. 1912-p179	Loc. Dic. 1912-p179	Am.Engr. 1913-p479	....	....	Loc. Dic. 1912-p225	Loc. Dic. 1912-p180	....	Loc. Dic. 1912-p168	Loc. Dic. 1912-p164	Loc. Dic. 1912-p163	....	Am.Engr. 1911-p457	Loc. Dic. 1912-p164	....	Loc. Dic. 1912-p204

*Locomotive Dictionary.

TYPICAL EXAMPLES OF RECENT PASSENGER LOCOMOTIVES

ARRANGED IN ORDER OF TOTAL WEIGHT

MOUNTAIN AND PACIFIC TYPES

Type	4-8-2	4-8-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2
Name of road	C. & O.	M. P.	P. R. R.	Erie	D.L.&W.	D.L.&W.	C. & O.	Exper.	N. Y. C.	Santa Fe	O.R.&N.	St.L.&S.F.	B.R.&P.	B. & O.	N. H.	Can.Pac.	C. of G.	S. P.
Road number or class	316	5201	8661	2900	1156	1106	181	50000	3426	1355	209	1058	601	5112	1095	1028	1655	908
Builder	Amer.	Amer.	Baldwin	Lima	Amer.	Amer.	Baldwin	Amer.	Amer.	Baldwin	Baldwin	Amer.	Amer.	Baldwin	Baldwin	C. P.	Baldwin	Baldwin
When built	1911	1913	1913	1913	1913	1912	1913	1911	1911	1912	1911	1912	1912	1913	1913	1912	1912	1912
Tractive effort, lb.	58,000	50,400	38,400	40,630	43,100	40,800	43,900	40,800	30,900	34,000	38,700	40,800	36,300	34,300	34,600	32,100	32,800	30,000
Weight, total, lb.	330,000	296,000	293,200	286,825	286,000	284,000	282,000	269,000	269,000	268,500	265,400	260,500	258,000	248,600	246,200	224,500	222,300	221,000
Weight on drivers, lb.	239,000	208,000	189,500	175,725	186,500	179,500	179,900	172,500	171,500	163,500	164,850	158,000	163,500	159,200	153,100	147,000	134,850	141,500
Weight on truck, lb.	44,000	48,000	46,100	....	49,000	50,000	51,300	49,500	50,000	54,600	50,150	55,000	49,000	49,300	49,100	41,000	43,150	37,600
Weight on trailer, lb.	47,000	40,000	57,600	....	50,500	54,500	50,800	47,000	47,500	50,700	50,400	47,500	45,500	40,100	44,000	36,500	44,300	42,000
Weight on tender, loaded, lb.	173,400	161,500	181,800	182,760	169,600	159,600	161,000	161,500	155,200	171,500	169,600	163,200	169,300	174,400	119,800	136,500	137,300	160,900
Wheel base, driving, ft. & in.	16—6	16—6	13—10	14	13—0	13—0	13—0	14—0	14—0	13—8	13—4	12—6	13—0	13—2	14—1	13—0	12—0	13—4
Wheel base, total engine, ft. & in.	37—5	36—5	35—2½	36—2	33—10	34—10	34—1	35—7	36—6	35—1	35—8	33—1	33—3	34—3½	35—3½	33—7	31—6	33—4
Wheel base, engine and tender, ft. & in.	70—6	70	60—2¼	68—4⅜	66—4	69—0	67—11½	68—2½	67—11	61—11	65—7½	64—9	65—11	60—8¾	63—4⅝	59—10	63—9½	68—6¼
Diameter of drivers, in.	62	63	80	79	69	73	73	79	79	73	77	69	73	76	79	75	69	77
Cylinders, number	2	2	2	2	2	2	2	2	2	4	2	2	2	2	2	2	2	2
Cylinders, diameter, in.	29	28	26	27	25	25	27	27	23½	17½ & 29	25	26	24½	24	24	22½	23	22
Cylinders, stroke, in.	28	28	26	28	28	28	28	28	26	28	28	28	26	28	28	28	28	28
Valve gear, type	Wals.	Baker	Wals.	Baker	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.
Steam pressure, lb.	180	170	205	185	200	200	185	185	200	210	200	175	200	190	200	200	180	200
Boiler, type	Conical	Conical	Belpaire	Straight	E. W. T.	Wooten	W. T.	Conical	Conical	E. W. T.	E. W. T.	E. W. T.	Conical	Straight	Straight	E. W. T.	Straight	Straight
Boiler, smallest diameter, in.	83¾	75¾	79¾	78	78	78	78	79	72	70	74	74	74	72	72	67⅜	70	70
Tubes, number and diameter in inches	243—2¼	218—2	202—2¼	199—2¼	265—2	252—2	206—2¼	207—2¼	175—2¼	199—2¼	356—2¼	247—2	240—2	140—2¼	180—2¼	175-2¼ 18-2	194—2	173—2
Flues, number and diameter in inches	40—5½	32—5⅜	32—5½	32—5½	36—5⅜	34—5⅜	36—5½	36—5½	32—5	26—5½	.....	32—5⅜	32—5⅜	25—5½	28—5½	22—5½	28—5⅜	24—5⅜
Length of tubes and flues, ft. & in.	19—0	20—0	21—0	22	20	20—0	20—6	22—0	21—6	21—0	22—0	20—0	20—0	20—0	21—6	19—6	18—0	20—0
Heating surface, tubes and flues, sq. ft.	3,795	3,165.2	3,453	3,575	3,769	3,579	3,535	3,800	3,192.9	3,233	4,593	3,471.50	3,394.4	2,359	3,132	2,770	2,526	2,477
Heating surface, firebox, sq. ft.	337	285.5	204	208	221	239	220	248	231.2	210	235	204.28	240.2	185	223	175	163	181
Heating surface, total, sq. ft.	4,132	3,450.7	3,680	3,813	3,990	3,818	3,786	4,048	3,424.1	3,443	4,860	3,675.78	3,635.0	2,567	3,355	2,945	2,689	2,658
Heating surface, superheater, sq. ft.	845	761	845	1,002	868	821	879	897	765	619	.....	758.60	757.0	587	730	539	605	580
Grate area, sq. ft.	66.7	56.5	55.4	66.6	58.0	94.8	59.6	59.75	56.5	57.6	70	50.9	56.4	56.5	53.5	45.6	50	49.5
Firebox, length, in.	114⅛	108⅛	110¾	114⅛	111⅛	126	114	114⅛	108⅛	109⅝	120	108	108	108⅛	108⅛	94⅛	132	108
Firebox, width, in.	84¼	75¼	72	84	75¼	108¼	75¼	75¼	75¼	76¼	84	68½	75¼	75¼	71¼	69⅞	84	66
Kind of fuel	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	An. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Lignite	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Oil
Tender, coal capacity, tons	15	14	17	14	10	14	14	14	12	12	15	14	15	16	13	12	13	2,940 g.
Tender, water capacity, gal.	9,000	8,000	8,000	8,500	9,000	8,000	8,000	8,000	7,500	9,000	9,000	8,100	9,000	7,000	6,000	5,000	7,500	9,000
Weight on drivers ÷ tractive effort	4.13	4.14	4.90	4.32	4.34	4.40	4.09	4.24	5.55	4.80	4.25	3.88	4.50	4.65	4.42	4.59	4.12	4.72
Weight on drivers ÷ total weight, per cent.	72.60	68.00	64.50	61.30	65.00	63.30	63.50	64.00	63.60	60.80	64.50	60.60	66.00	64.10	62.10	65.50	60.70	64.20
Evap. heat. surf. ÷ superheater heat. surf.	4.88	4.90	4.36	3.80	4.60	4.64	4.31	4.50	4.48	5.57	....	4.64	4.80	4.38	4.61	5.46	4.46	4.58
Firebox heat. surf. ÷ total heat. surf., per ct.	8.17	8.25	5.55	5.45	5.55	6.30	5.80	6.14	6.72	6.10	4.83	5.56	6.62	7.18	6.70	5.95	6.05	6.82
Firebox heat. surf. ÷ grate area	5.05	5.06	3.63	3.12	3.81	2.53	3.69	4.14	4.08	3.64	3.36	4.02	4.26	3.28	4.17	3.83	3.26	3.66
Total heat. surf. ÷ grate area	62.00	61.00	66.30	57.2	68.60	40.30	63.60	67.70	60.70	59.80	69.50	72.00	64.50	45.50	62.80	64.50	53.90	53.60
Tractive effort × diam. drivers ÷ heat. surf.	870.00	926.00	833.00	840.00	745.00	782.00	849.00	800.00	714.00	721.00	610.00	766.00	730.00	1,019.00	815.00	818.00	840.00	871.00
Total weight ÷ total heat. surf.	80.00	85.40	79.80	75.20	71.90	74.50	74.60	66.60	78.60	78.00	54.60	71.10	71.00	97.00	73.00	76.20	82.60	83.00
Volume of cylinders, cu. ft.	21.40	20.00	16.00	18.54	15.90	15.90	18.54	18.54	13.04	12.62*	15.90	17.20	14.20	14.55	14.55	12.80	13.44	12.32
Total heat. surf. ÷ cylinder volume	193.00	172,54	230.00	206.00	251.00	240.00	204.00	218.00	262.00	272.00	306.00	218.00	256.00	176.50	231.00	230.00	200.00	215.00
Grate area ÷ cylinder volume	3.12	2.83	3.46	3.59	3.64	5.96	3.21	3.22	4.34	4.57	4.40	2.96	3.96	3.89	3.67	3.56	3.72	4.01
Reference for photograph, drawings or description	Am.Engr. 1911-p381	Am.Engr. 1913-p585	....	†D.R.A.G. 1913-p1392	....	Am.Engr. 1912-p391	....	Am.Engr. 1912-p5	Am.Engr. 1911-p133	Am.Engr. 1912-p517	Am.Engr. 1911-p256	Am.Engr. 1912-p189	Am.Engr. 1912-p251	....	D.R.A.G. 1913-p1294	....	Am.Engr. 1912-p372	....

*Equivalent simple cylinders. †Daily Railway Age Gazette.

WATERING THE RAILS TO PREVENT SLIPPING

Watering the tires and greasing the flanges of locomotive wheels are two operations which are carried out by similar means, but which have totally different effects. The first is intended to increase the adhesion between wheels and rails; the second is intended to reduce the friction between wheel flanges and rails on curves. Unless great care is taken in the use of such watering or greasing devices, there is a considerable risk of obtaining an effect contrary to that desired.

Locomotives are designed to have sufficient adhesion; nevertheless this may occasionally become reduced so that the wheels slip. This generally happens in starting, or on long up-gradients, or in tunnels, or in certain atmospheric conditions. Several methods have been devised for remedying this want of adhesion. The most usual one is to run sand on the rails. In recent years, instead of this method for which absolutely dry sand is required, steam sand-sprayers have been used which project wet sand on the rails. But there are serious disadvantages when it has frequently to be used at the same places, and attempts have been made to do without it and replace it by watering the rails.

Numerous cases of wear on the rails due to the action of sand have been observed at many places, in particular in the Hauenstein tunnel, 1.86 miles from Olten, Switzerland, where the rails laid in the end of 1870 showed the following renewals, when the five years' guarantee expired:

Rails laid in the tunnel	111.76 per cent
Rails laid outside tunnel	1.66 per cent

In this tunnel the use of sand has been entirely eliminated, and a jet of water is used instead; this has given excellent results.

There is a phenomenon well known to all enginemen: when the rails are damp, in times of fog, the locomotive wheels slip; while if heavy rain wets the rail thoroughly, no slipping takes place. Hence the method of watering the rails in order to avoid slipping at once suggests itself.

In 1859, locomotives of the classic Bourbon type were fitted with a cock and a pipe which made it possible to send water under pressure to the rails.

At the meeting of the Société des ingénieurs civils, held on May 7, 1875, Mr. Mallet stated that no sand, but a strong jet of water which washes the rails perfectly, was used on the railway which runs from Zurich to the top of the Uetliberg.

About thirty years ago the transport of iron ore in the Mazeray mines, belonging to the Creusot firm, was effected in the Sainte-Marguerite heading, by means of small locomotives, which worked very well, except on an up-gradient, 394 yd. in length, where there was much trouble in consequence of the slipping of wheels. This caused delays and irregularities in the service, increased consumption of fuel, and excessive wear of the tires. A lucky chance showed how these troubles could be prevented. The blow-off cocks of the cylinders started leaking, and the escaping steam happened to strike the rails, so that these were cleaned; the slipping at once stopped. Struck by this unexpected result, the engineer in charge of the locomotive department had the blow-off cocks altered in such a way that they discharged straight at the rails. At the moment the up-gradient was reached, the cocks were opened a little, the rails were cleaned and the train ascended without trouble. The traffic (80 to 100 tons per day) had cost 0.227 franc per ton per kilometer for traction; this cost was reduced to 0.012 franc by the mere alteration of the blow-off cocks.

Theory and practice agree that washing the rails is an effective means for preventing slipping. Attention must, however, be given to the consideration that mere wetting does not suffice; on several railways it has been observed that this reduced the adhesion rather than increased it, because too little water, or water at too low a pressure was used. The best results have, on the contrary, been obtained by using a strong jet of water able to wash off the rails any dirt which was sticking to their running surface.

A useful effect can be obtained by using the blow-off cocks of the cylinders, as in the instance of the Creusot locomotive mentioned above, but it is only possible to use them in the case of locomotives making very short runs, such as mine locomotives.

In the case of an ordinary railway, a special appliance is required. This appliance can be arranged, according to circumstances, either to take the water and steam required from the boiler direct, or to take live steam from the boiler and water from the tank, or to utilize the exhaust steam from the locomotive and water from the tank.

In an appliance of this kind, which is of a simple character, water is taken from the boiler through a cock operated by a rod, the handle of which is within reach of the engineman. The liquid, under pressure, passes through this cock and through a pipe carried down outside the boiler to a tee piece placed centrally; there the current divides and passes into two horizontal pipes, the ends of which are bent down and fitted with nozzles, from which issue the jets washing the rails.

The way in which this appliance is supported deserves special mention. Locomotives running on lines with sharp curves generally have axles with lateral play and the displacement of the frame of the locomotives relatively to the track is generally rather considerable, hence the nozzles must not be fixed to the frame or else the jets would frequently miss the rails. It is, on the contrary, necessary to connect them with the axle, as its wheels necessarily remain in the same position relatively to the track. In the case of this appliance, a triangle supporting the tee piece is hung from the axle and moves with it. The nozzles are hung from the frame, but by means of rods and swing links, a construction which enables them to move with the axle and to remain always directed at the rails.

The appliance which has just been described consumes much water and steam, and this gives rise to trouble if the boiler is not very powerful. Hence attempts have been made to take water from the tender and to take from the boiler only the steam necessary to give the water the velocity required. This method has been applied on the locomotives used in the Hauenstein tunnel.

These locomotives were fitted with a steam cock placed on a branch from the whistle tube, a water cock fitted to the water tank, an ejector in which the steam pipe and water pipe just mentioned terminate, and the pipe from the ejector, leading the mixture of the steam and water to the front of the locomotive. This pipe divides into two branches, each ending in a nozzle placed 2⅜ in. above the rail and inclined at an angle of 15 deg. to the vertical.

The consumption of water was about 11 English gal. per minute, with an ejector having a steam pipe of 7/32 in., a water adjustage of 13/64 in. and a divergent cone of 3/16 in. The bore of the pipe from the ejector to the tee piece was 1 13/16 in., and that of the branches 31/32 in. Finally the nozzle projecting the water on the rail had a diameter of 5/32 in.

With this appliance it was possible, on a straight track, to project on the rails a jet of water having a temperature of 60 deg. C. (140 deg. Fahr.) and a velocity of 91.87 ft. per second; this suffices for a thorough cleaning of the running surface of the rails.

Instead of using live steam for working the ejector, exhaust steam may be used; in that case, no extra steam is required.

The exhaust from the cylinders of the locomotive gives a strong enough jet to propel the water for washing the rails, but the exhaust from the air pump is not sufficiently strong for the purpose.—*Bulletin of the International Railway Congress.*

CAR DEPARTMENT

FREIGHT CAR REPAIRS*

BY C. L. BUNDY

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In the December, 1913, number of the Railway Age Gazette, Mechanical Edition, appeared the question (among others) "If a damaged car comes on the repair track with a number of parts broken in fair usage, is it wisdom or economy to replace the broken parts with the same design and construction?" As a mechanical man who has had a number of years' experience in the car department, I should say this would be poor practice. If the parts failed in fair usage, there could be no assurance that they would not fail again before the car reached the next divisional point.

Railroad officers have watched the growing cost of repairs to freight cars for a number of years, and it can be attributed to a number of reasons:

First, the rapid introduction of heavy power during the past few years. The railroads had in use a large number of cars, built prior to the introduction of this heavy power, of wooden construction and with short draft timbers extending back only to the body bolster. When these cars were built the power was light and 30 cars was considered an average train; but today trains have increased to 60 and 80 cars and some railroads still maintain their old cars as they were originally built. Such cars will not stand up in the heavy trains of the present day.

Second, we find these light cars switched in trains indiscriminately, and going over the road badly sagged and leaking grain in many places. If these cars were favored by being placed at the rear of trains, it would result in less failures, but this would entail an additional expense in switching and would, no doubt, meet with many objections from the operating department.

The third most important cause of the high cost of repairs to freight cars is the starting of trains where it is necessary to take the slack a number of times before they can be gotten under way. This results in much damage, especially to couplers, draft timbers, center sills and end sills. Cars are also frequently damaged in terminals in switching over hump yards.

These, I think, are the main reasons for the many failures and the high cost of repairs to freight cars. As the heavy power has proved to be the most economical from an operating standpoint and has come to stay, why not build or rebuild our freight cars so that they will stand the service? If we do this, in a short time the cost line, instead of going up will turn downward until it finds the lower level to which it belongs.

My experience has showed that the most frequent parts to fail on freight cars are draft timbers, draft gears of the old spring type, couplers, coupler rivets, longitudinal sills and end sills. This being the case, it proves conclusively that these are the parts that should be strengthened. Railroads should, in my opinion, select such of their equipment as it will pay to spend money on and put it in condition to stand the conditions of modern service.

The first and most important thing to do is to apply steel underframes. The next consideration is the draft gear. There are many failures of other parts that can be attributed to an inadequate draft gear. I believe there are about three-fourths of the freight cars in service today equipped with the old spring type draft gear with a capacity not over 20,000 lb., and these cars are still being maintained—just why, I am unable to explain, unless the first cost is less than that of the friction draft gear. If this is the case the difference in cost is soon thrown away in the maintenance of the spring gear, to say nothing of the cost of the many other parts that require repairs on account of inadequate draft gears.

The ends of old wooden cars are a source of trouble. The end posts, being tenoned into the end sills and end plates, offer little resistance to shifting loads and are often pushed out in ordinary switching. These should not be maintained as originally built, but should be strengthened by putting in the all-metal corrugated steel end or by replacing the old posts and braces with metal ones sufficiently strong to withstand the shifting of loads in switching service.

The side door is another part of the car that has been provided with inadequate fixtures. Many cars are found with wooden door stops lagged or bolted to the door post and the seal lock bolted on the stop with two ⅜ in. bolts. The result is that the stop becomes split from the shocks in ordinary switching service. The door hasps are secured to the door with a ⅜ in. bolt, resulting in the door siding giving way. Many doors are also damaged at the loading platforms, by being opened, when warped, with bars and sledges. To maintain doors of this design helps greatly to run up the cost of repairs, renewing these parts as often as it must be done. The door stop should be of metal and the seal lock riveted on, and the hasp should be secured to a metal strip running back at least one-half the width of the door. Angle irons should be bolted across the door to prevent its warping, and the bottom of the door should be protected with an angle iron to prevent wear against the guide brackets. In addition to this the doors should be made secure, if for no other reason than that they are liable to fall off or swing out at the bottom, striking passenger trains and injuring passengers. At this time, when the safety first movement is being taken up by all railroads, this matter should be taken up vigorously and the side door put in condition to perform its duty in a more satisfactory manner than it has done in the past.

Another part of the freight car which has cost railroads large sums of money to maintain is the roof. There are varied opinions among car men as to the best construction for car roofs. Looking back a few years, the major portion of the cars built had the double board roof, well painted between the two courses; a little later, some of the roads applied a heavy plastic roofing paper between the boards. This style of roof proved unsatisfactory, as the boards would shrink and water would find its way down around the nails, which had become loose, due to the weaving movement of the car.

Then came into use, and especially on refrigerator cars, the roof called the torsion proof paper roof. The paper was applied in sheets, the top ends overlapped each other at the ridge pole and the sides of the sheets were set in a groove in the sub-carline. This roof was not a success as the sheets were continually getting out of place and causing leakage.

Next came the metal roof with the sheets extending across the car from side plate to side plate and nailed at the ends. This style of roof invariably gave way along the ridge pole and at the ends. It was followed by the inside metal roof with the sheets extending only to the ridge pole in the center of the car. This roof proved to be the best design and is used quite extensively at the present time.

However, in order to get as much clearance as possible, the outside metal roof was extensively used by many railroads. These roof sheets were laid on one course of boards, usually placed lengthwise of the car. The sheets overlapped each other at the top and along the sides and were secured to the side fascia by means of clips. This design was too rigid to accom-

*Entered in the Car Department competition which closed February 1, 1914.

modate itself to the torsional movement of the car in service and would give way at the lower end, so that the wind and water would blow under the sheets. The result was that many claims were paid on account of goods damaged in transit, and it became general practice to make inspection of cars before loading with cement or other freight which is liable to damage on account of roofs leaking.

The all metal roof applied to cars of recent build looks to be a roof that will give satisfaction, but I do not think it advisable to apply this kind of roof to old wooden cars, as the superstructure is not sufficiently strong. However, I do think we should use on reconstructed cars the inside metal roof, which will accommodate itself to the weaving and torsional movement which these cars undergo.

I have dealt briefly with some of the most serious troubles with freight cars, and I am fully convinced that if the managements of our railroads would see the freight car in this same light and follow out the suggestions as to the kind of repairs we should make in bringing our cars into condition to meet the service, in a short time we would not only feel the good effect in the way of reduced maintenance costs, but we would also eliminate many of the delays to traffic due to cars failing in trains on the road. At the same time the claims resulting from defective side doors and leaky roofs would be greatly reduced. Railroad officers should rely on the mechanical men, who are handling the equipment and have the responsibility of keeping it in repairs. They are the best judges, in my opinion, as to what construction will last longest and give the best results, and help keep down the high cost of maintenance.

THE CLASP BRAKE*

BY F. M. BRINCKERHOFF

No greater safeguard against injury to passengers or rolling stock can be provided on a car than an adequate brake equipment.

While the power obtainable from the air brake cylinder can be increased to any desired extent, the means for effectively applying this force to the brake shoes and to secure maximum retardation, is a matter requiring thorough study in all details, both of foundation and truck brake gear.

In a recent test of a modern air brake equipment on cars fitted with clasp brakes, two shoes per wheel on all eight wheels, stops were made from speeds of 55 miles per hour in 16 seconds, during which the cars proceeded 720 ft. The cars tested are 72 ft. in length overall, and weigh, complete with motive power, 119,500 lb. each. As the electro-pneumatic brake equipment employed provides for the simultaneous application of the brakes on every car of the train, regardless of the train length, the above rate of braking would permit of bringing a train of ten such cars from a speed of 55 miles per hour to a standstill while traversing a distance equal to its own length. It is of interest also to remark that the tests referred to were protracted to the extent of making 258 test stops from speeds ranging from 30 miles per hour to 57 miles per hour. The total distance traveled during the tests was 270 miles.

The total brake shoe pressure per car in emergency stops was 174 per cent of the weight on the wheels. No wheel sliding occurred, and the emergency stops, while abrupt, did not disturb the standing observers, there being practically no reaction. Brake leverage ratio was 9 to 1.

As a matter of interest, the actual piston travel necessary to make full emergency application, running or standing, is 3½ in., though in operation the automatic slack adjuster is set to operate at 5 in.

Two brake cylinders per car are used to secure the power. Each truck has its own brake cylinder, foundation brake gear and hand brake rigging complete, and entirely independent of the other truck except that both cylinders are supplied with air from the one control valve.

The purpose of the test was to determine the relative retardation efficiency of simple brakes and of clasp brakes for high speed service. It was found that about 18 per cent was gained in time of stop, and about the same in distance, by the use of clasp brakes instead of simple brakes. The two tests were absolutely identical as far as the brake rigging was concerned; the only change made was, that in the clasp brake tests we used two shoes per wheel and in the simple brake tests we used one shoe per wheel. The total shoe pressure per wheel was the same in both cases.

The cars are all equipped with two brake cylinders and with independent brake rigging for each truck, in order to leave the center of the car between the trucks free for the application of motive power control apparatus. Another reason for separating the brake rigging was to give a greater factor of safety for single car operation. If the brake rigging fails on one end of the car, there still remains half the braking power of the complete car on the other truck.

The simplicity of the hand brake rigging on this car is illustrated by the fact that 48 per cent of service brake power per truck can be obtained by the application of 100 lb. pull on the hand brake handle. This makes a good service stop.

Analysis of the weights of truck members as influenced by the design will disclose means for marked reduction in truck weight while in no way reducing the strength of the complete structure. The extensive use of passenger trucks without equalizer bars on a large steam railroad system warrants the full consideration of this type of truck, with a view to securing the marked reduction in weight possible with this construction.

In my estimation, trucks designed today should either be fitted with clasp brakes or be designed with provision for their ultimate application. It is seldom that a fully efficient clasp brake rigging can be applied to a truck designed for simple brakes. The best braking results will therefore be secured by designing the truck specially for clasp brakes, as otherwise the sacrifice of many features advantageous to the clasp brake system will have to be made later, on account of truck frame interferences or limitations.

Aside from the improved stopping capacity secured by the use of clasp brakes, there is a notable increase in mileage per shoe realized on account of the more efficient working temperature of the clasp shoe system, with its lower pressure per square inch of working surface. This saving appears, in regular service aggregating about two million car miles, to amount to approximately 18 per cent.

An incidental and very important result of the use of clasp brakes is the minimizing of hot journal troubles by their use. This is obviously due to the fact that during braking the two shoes press with equal force on opposite sides of the same wheel. There is, therefore, practically no disturbance of the journal brass, which consequently retains its accustomed accurate fit on the journal.

This same clasping action of the brake shoes relieves the journal boxes and pedestal guides of considerable of the strain and wear incident to the simple brake, and as there is no binding of the journal boxes in the guides when braking occurs, the riding quality of the truck is not affected at such times.

Stresses on journals will in like manner be materially reduced by the use of clasp brakes.

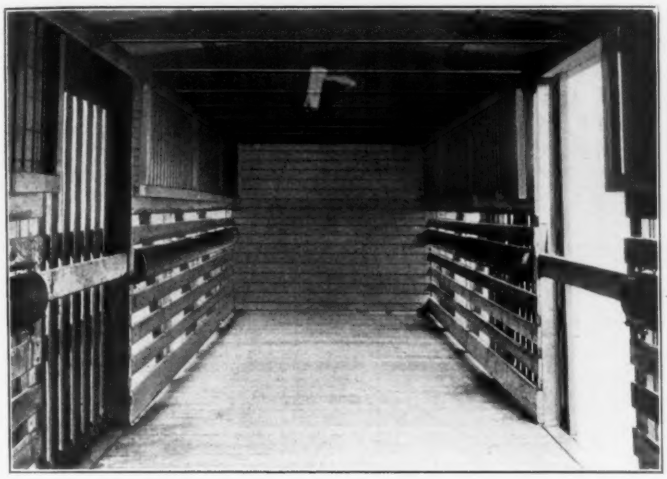
*From a paper read before the New England Railroad Club, February 10, 1914.

Locomotive Boiler Design.—The goal of boiler designers is to obtain the largest number of pounds of steam to each pound of metal in the boiler. The various studies and experiments have clearly indicated the advantage of the use of a longer flameway between the fuel bed and the end of the tubes, giving an opportunity for completing the gas reaction before the products of combustion enter the flues.—*Railway Age Gazette.*

Northern Pacific Stock Car

Strong End Construction and Combined Steel and Wood Underframe Which Employs Truss Rods

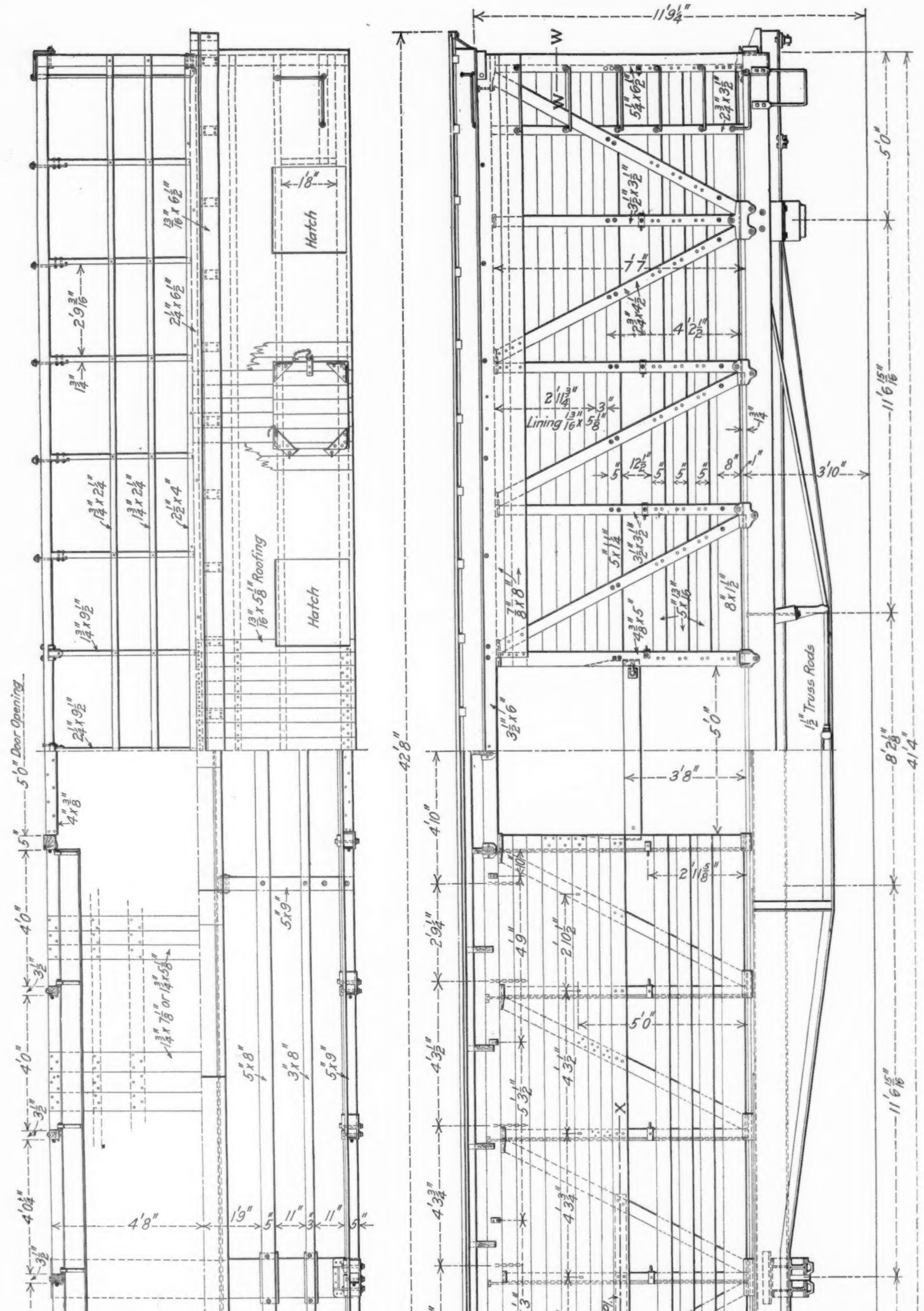
The Northern Pacific has recently placed in service 250 stock cars that have many interesting features. The cars were designed by the railway company and include standards that are common to all the box cars built for this road. While the cars were built primarily for stock service they were made of sufficient strength to carry other commodities that could be conveniently carried in such a car. They are built with a combination steel and wooden underframe, steel being used for the center sill, which is a fish-belly girder, the bolsters and the end sills. No nails are used in the body of the car up to a height that would come in contact with the cattle, carriage bolts being used to fasten the sheathing to the framing. All sharp corners are rounded and the large bolts are countersunk for the same reason. All lumber used throughout the construction is Oregon fir.



Interior of the Northern Pacific Stock Car

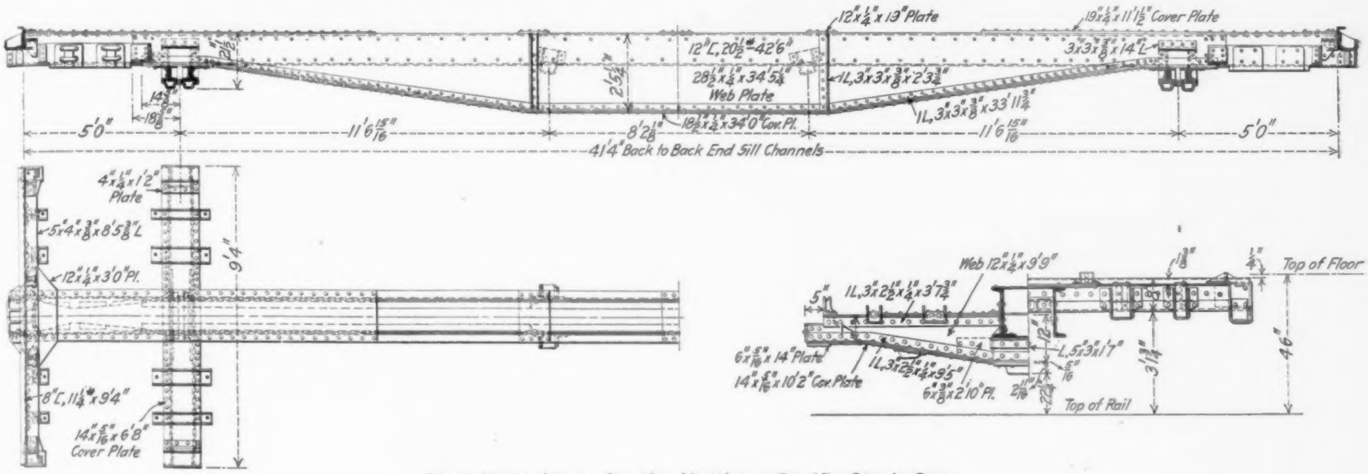
The underframe is of special interest, the design being the Northern Pacific standard for all wooden freight cars. It is made up of a fish-belly girder for a center sill and built-up steel bolsters and end sills, wooden side and intermediate sills, wooden needle beams 4 ft. 1 in. each side of the center of the car, and two truss rods, one under each side sill. The center sill is designed to take care of both the buffing strains and the bending strains due to the load. It extends the full length of the car and is of the double web type. Two 12 in., 20.5 lb. channels extend the full length of the car and form the upper chord of the girder; these channels take care of the buffing and draft strains. The depth of the girder at the center of the car is 29¼ in., which gives a section modulus of 240 around the horizontal neutral axis taken at that point. The web plates are ¼ in. thick and are riveted to the webs of the channels. They extend between points 18⅝ in. outside of the center line of the bolsters. The depth of these plates for 2 ft. 6⅝ in. on each end is 11½ in. They then taper to the maximum depth of 28½ in., which is maintained for 4 ft. 9 in. each side of the center of the car. A 3 in. by 3 in. by ⅜ in. angle is used at the bottom of the plate for the connection to the bottom cover plate which is 18½ in. wide and ¼ in. thick. These plates and angles are 8 in. shorter than the web plates. The web plates are further stiffened at the limit of the maximum depth by 3 in. by 3 in. by ⅜ in. angles 2 ft. 3¾ in. long, placed vertically on the inside of the web plates. The top cover plate for the center sill consists of two plates 19 in. by ¼ in. and 11 ft. 1½ in. long, and three tie plates 19 in. by ¼ in. and 12 in. long. One of the large plates is riveted to the channels at each end of the center sill, just inside of the end sill. One of the tie plates is

Stock Car of 80,000 lb. Capacity for the Northern Pacific



General Arrangement of the Northern Pacific 80,000 lb. Capacity Stock Car

located at the center of the car, and the other two just over the vertical angle iron web stiffeners. The needle beams are located 4 ft. 1 in. each side of the center of the car, being supported at the center sill in pressed steel pockets and at the side sills by the truss rods. These truss rods extend the full length of the car, passing up over chairs located on top of the bolsters and extending through the end sills, where they are bolted to the steel end

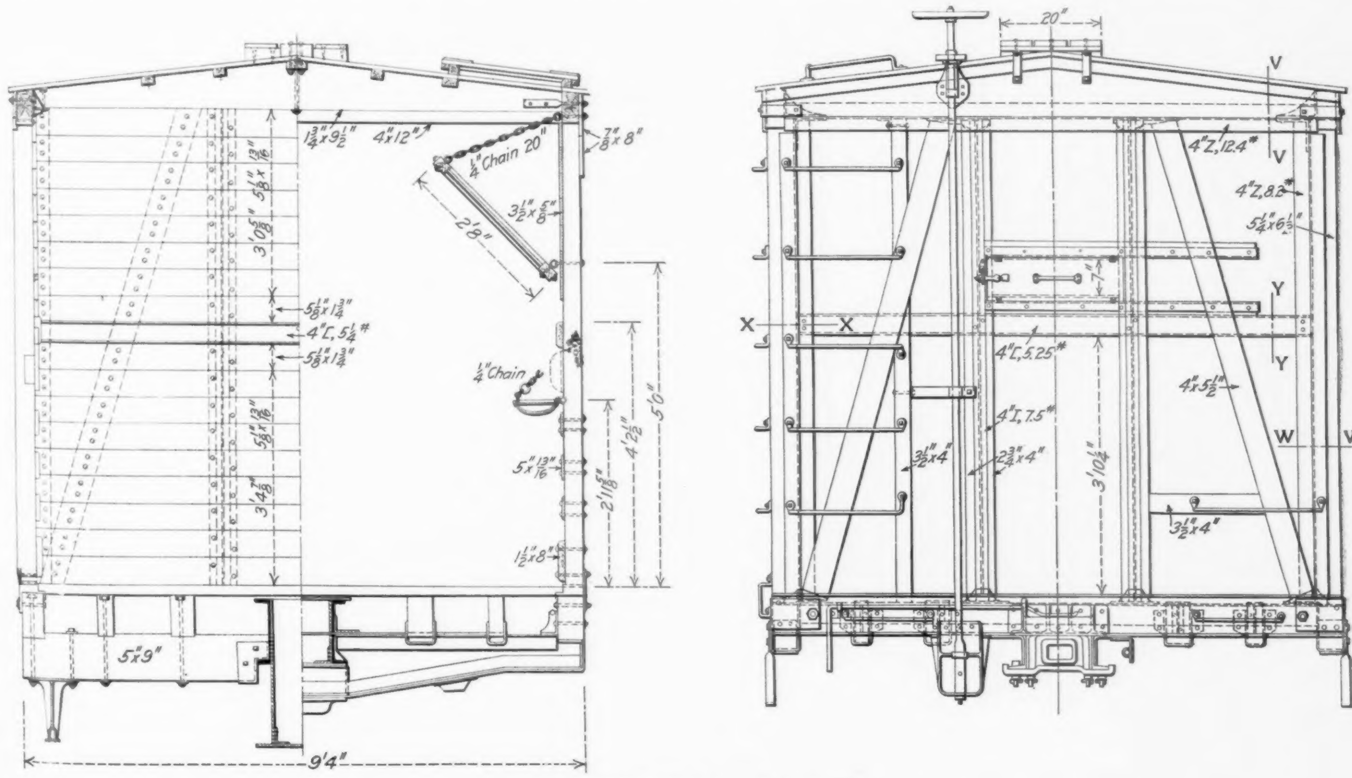


Steel Underframe for the Northern Pacific Stock Car

sill construction. The salient feature of this underframe is ample strength and the ease with which it may be repaired. Being made up of standard structural shapes it may be easily repaired at any shop along the line.

The side sills are 5 in. wide by 9 in. deep and extend the full length of the car, resting on shoulders made in the bolster, as shown in the drawings, and supported in pressed steel pockets securely riveted to the end sills. There are four intermediate longitudinal sills. Those nearest the center sills are 5 in. by 8 in. and the other two 3 in. by 8 in. These sills extend the full length of the car.

The superstructure has a heavy end construction and the side frames are well proportioned. The corner posts are 6½ in. wide by 5¼ in. deep and are cut away in one corner, as shown, for the sheathing which is bolted to them. They are provided with a cap and shoe of malleable iron and are reinforced by 4 in., 8.2 lb. Z-bars which are set into the corner posts as shown, flush with the outside end face of the corner posts. These Z-bars are attached to the corner posts by ½ in. bolts, extending through the outer flange and through the web. The intermediate end posts are 4 in., 7.5 lb. I-beams with 2¾ in. by 4 in. wooden fillers placed each side of the web. The outside faces of the I-beams are set on a line with the face of the corner posts, and are fastened to the steel end sills by angles in the same manner as are the steel Z-bars of the corner posts. The end framing is further reinforced by two 4 in. by 5½ in. diagonal braces.

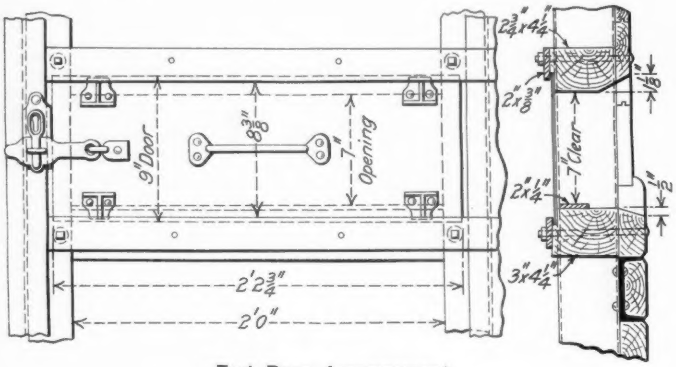


End Elevation and Cross Sections

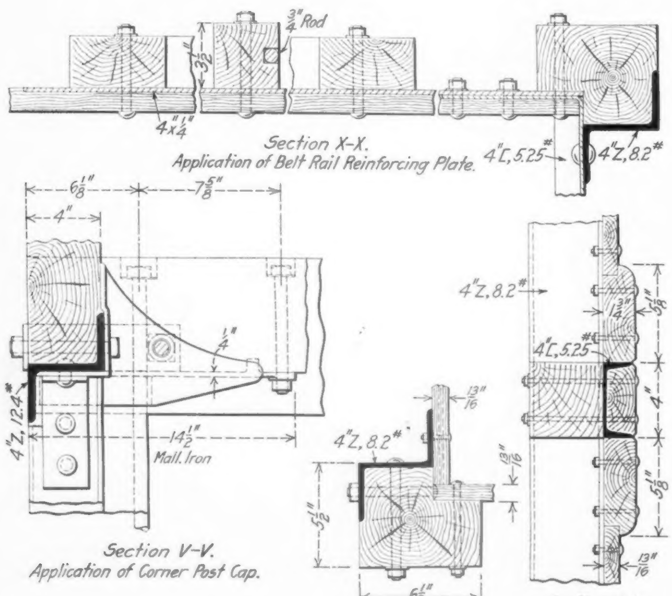
The end belt rail is a 4 in., 5.25 lb. channel, which extends between the corner posts with its web flush with the outside of the end sheathing. As shown in Section *XX*, the flanges at each end of the channel are cut away and the web bent at an angle of 90 deg. for about 7 in., extending along the side belt rail and

bolted to it. In addition to this there is a reinforcing plate 4 in. wide by 1/4 in. thick and 7 ft. 1 in. long which extends along the side belt rail and is bolted to the overlapping portion of the end belt rail. The end plate is 4 in. thick and 12 in. high at the center. It is reinforced by a 4 in., 12.4 lb. Z-bar which extends from corner post to corner post. It is further reinforced by a 3/8 in. tie rod extending from side plate to side plate. The end door shown is to be used when the cars are used for hauling lumber.

The side of the car is built up of 12 vertical posts and 16 diagonal posts, with the four door posts for the middle doors. Each of the vertical posts and the door posts are held to the side plate and side sill by 3/4 in. tie rods. The side posts and diagonal braces are set in malleable iron pockets and caps in both the side sill and the side plates. Sheathing 13/16 in. thick is used for the lining at the ends of the car as well as for the slats. The upper sheathing on the side of the car is 13/16 in. thick, and 5 1/8 in. wide. The side belt rails are 5 in. by 1 1/4 in. The roof is provided with 13 carlines 1 3/4 in. thick, which are held to the side plate by 1/2 in. strap bolts. The purlins are 1 3/4 in. by 2 1/4 in. and the ridge pole 2 1/2 in. by 4 in.



End Door Arrangement



Northern Pacific Stock Car Framing Details

The cars are provided with both water troughs and hay racks, the hay racks being loaded from six hatches in the roof on each side of the car. In applying these devices every means was taken to cover all the corners and sharp projections so that no injury could be done to stock. A hole is provided in the partitions between the sections of the water trough about an inch above the bottom of the trough, so that the amount of water in the various compartments may be equalized when the car stands on track that is not on a level.

The special appliances employed are as follows: Camel Company doors, McCord journal boxes, Westinghouse air brakes, 675 lb. Griffin chilled iron wheels, Barber rolling truck device, H. W. Johns-Manville sill covering, Camel Company door fixtures, Miner draft gear, Sharon couplers and National end door locks. The side frames and truck bolsters are the design of the Northern Pacific Company and are bought as steel castings. The cars were built by the Whipple Car Company, Chicago.

The following are the general data:

Capacity	80,000 lb.
Light weight	39,500 lb.
Length, back to back of end sill channels	41 ft. 4 in.
Height of eaves from top of rail	11 ft. 9 1/4 in.
Width over side sills	9 ft. 4 in.

HEATER CARS

While the demand for heater cars is not nearly as great as for cars under ice, it is often necessary to provide some means of protecting perishable freight from the cold. Some roads heat the cars at the loading points, relying on the insulation to hold the heat until the car reaches its destination. This system is quite satisfactory in moderate temperatures, but under more severe conditions it is necessary to place some portable heater in the car and carry it to the destination. At a slight additional expense it would be possible to construct refrigerator cars with a scientific system of heating, and as this class of traffic grows such systems probably will be more common. Refrigerator cars having the overhead icing system are also provided with a heater system. The inside sheathing of this design of car is wholly surrounded by an air space through which the cold air in summer, and the hot air, when the heater is used, circulate. In addition, provision is made for direct circulation in the inside of the car.

Other designs are also used for combination refrigerator and heater cars. This is a system that may be readily applied to any existing refrigerator cars by the simple addition of a series of four ducts in the floor, extending from the heater units in the middle of the car to the end bunkers. Two of the ducts deliver the heated air to the bunkers about half way up the end of the car; the other two are the return ducts, and extend but a short distance up from the floor on the end walls. The heat from the delivering ducts will rise to the top of the bunker and pass over the top of the bulkhead, and as it becomes cooled, it will return through the bottom of the bulkhead, returning to the heater through the return ducts.—*Railway Age Gazette.*

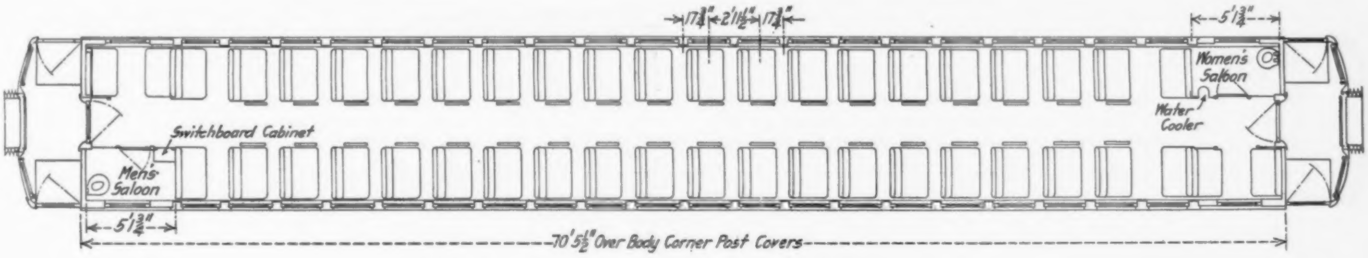
CAR LIGHTING

The illumination of passenger cars can be greatly assisted by suitably curving the headlining, finishing it in white or other good reflecting color, and appropriately locating the source of light. Many forms of globes, shades and reflectors have been developed for car lighting, and the end is not yet in sight. On roads where electricity is the motive power, it is, of course, a simple matter to provide ample light, but where cars must be illuminated by a supply of gas or electric power carried on the car, the question of its economical use must be considered. Aside from the cost of fixtures, the most pleasing illumination is secured by the use of comparatively small units of light, evenly spaced along the center of a ceiling having an outline specially formed and colored to reflect and diffuse the light. Indirect lighting systems have been tried for car illumination, but are essentially uneconomical. Semi-indirect lighting systems give good results, however, and, when combined with a suitable outline and color of ceiling, are effective, extremely agreeable to the eye, and give absolutely shadowless illumination. Fixtures of this type are suitable for use either with gas or electric light. —*F. M. Brinckerhoff before the New England Railroad Club.*

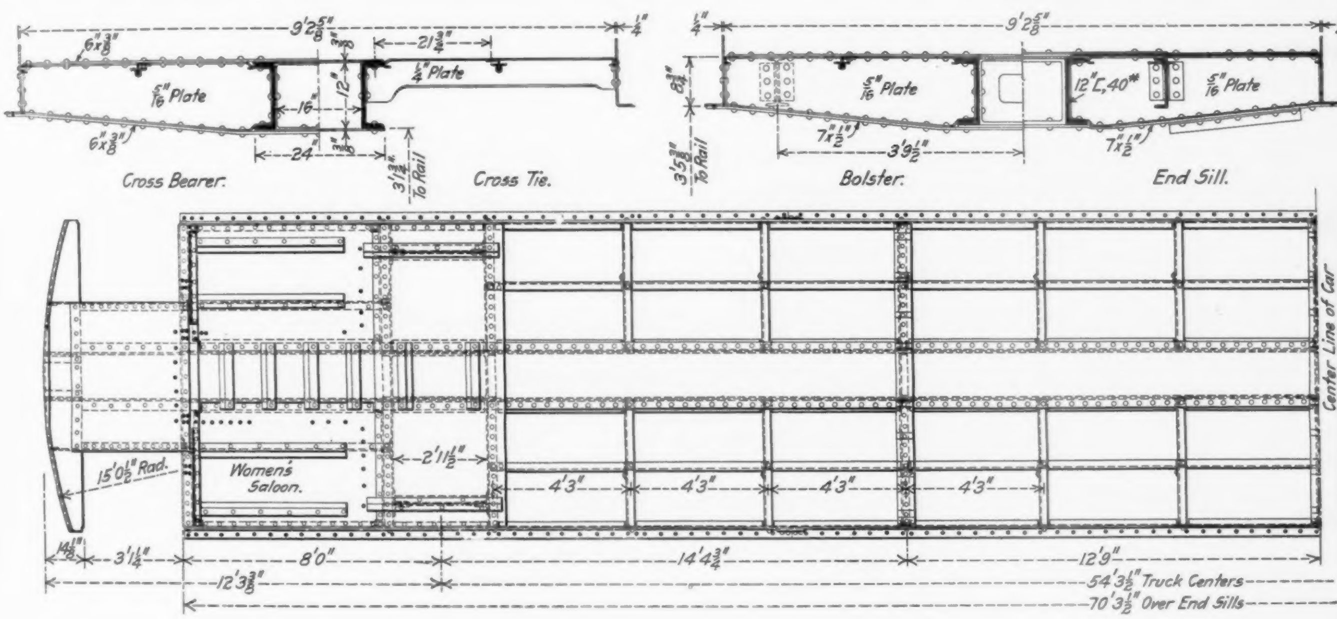
NEW HAVEN STEEL COACH

Announcement was made by the New York, New Haven & Hartford during the fall of 1913 that an order had been placed for 150 all-steel day coaches. The New Haven now has a large number of these cars in regular service, the first having been placed on the road early in November last.

These cars are 70 ft. 3½ in. long over the end sills, have a seating capacity for 88 passengers and weigh 131,000 lb. The weight of the car body is 89,000 lb., and that of the two trucks 42,000 lb. The center sills extend throughout the length of the car and consist of 12 in., 40 lb. channels with top and bottom cover plates 24 in. by ⅜ in. There are two cross bearers placed 12 ft. 9 in. on either side of the center line of the car. These consist of pressed channel sections of 5/16 in. plate with a 3 in. flange and are reinforced by 6 in. by ⅜ in. top and bottom cover plates extending the full width of the car. The truck centers are placed 54 ft. 3½ in. apart and the body bolsters are built up of 5/16 in. channels with a top cover plate 48 in. by ¼ in., and two bottom cover plates 7 in. by ½ in., all three extending the full width of the car. There are 18 cross ties extending between the center sill and the side sill and supporting an intermediate floor stringer on either side of the car. These cross ties are of channel section pressed from ¼ in. plate and are 5 in. deep with a 3 in. flange. The side sills are 3½ in. by 3 in. by ¼ in. angles and extend the length of the car. The end sill is a 5/16 in. pressed channel with a 7 in. by ½ in. bottom cover plate extending across the car. A 9 in., 13.25 lb. channel, 2 ft. 2¾ in.



Floor Plan of 70 Ft. Steel Coach on the New Haven

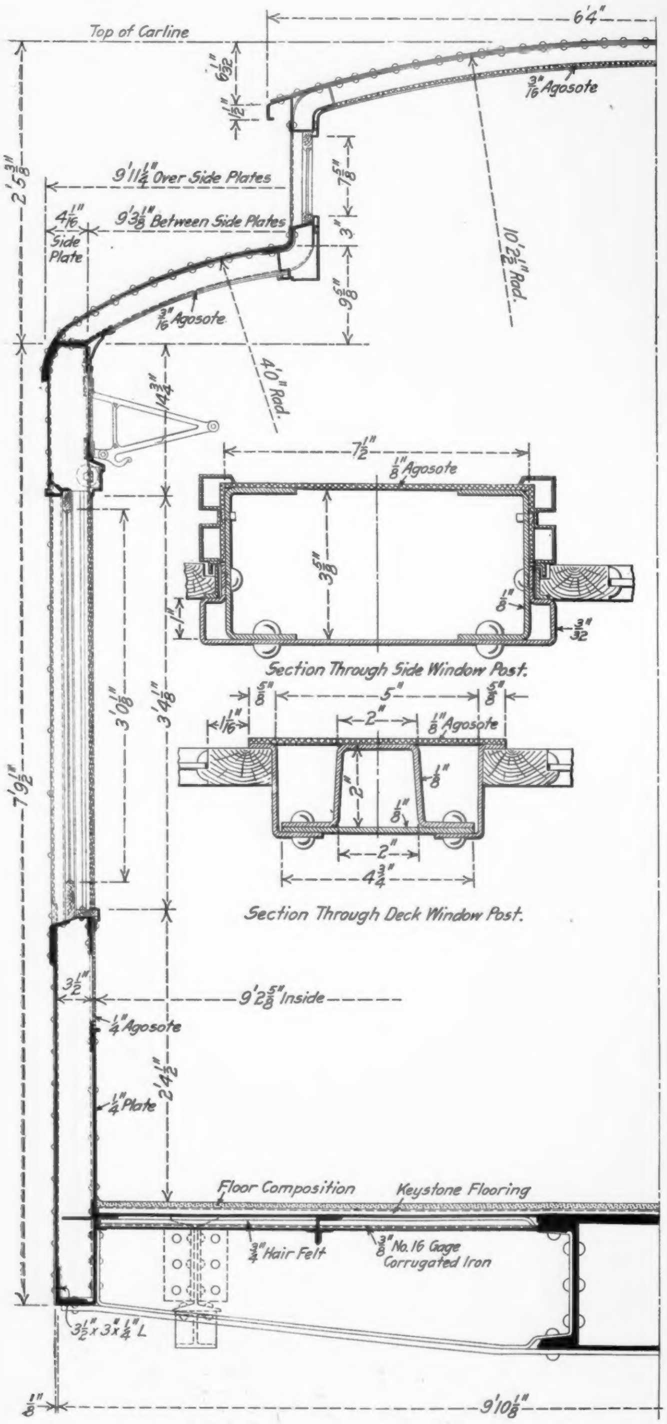


Arrangement of the Underframe of the New Haven Steel Car

New York, New Haven and Hartford Steel Day Coach

on either side of the longitudinal center line of the car extends from the platform end sill to the body bolster.

Keystone flooring is used with a floor composition above and a layer of ¾ in. hair felt below. The inside finish consists of ¼ in. Agasote below the windows and 3/16 in. Agasote above. The 3/16 in. Agasote is also used in both the upper and lower decks. The interior of the car is finished in grained mahogany with the ceiling or deck in green with gold ornamentation.



Sections Through the New Haven Coach

Mahogany is employed for the window sash. The interior hardware is finished in statuary bronze.

Among the specialties used in the car are the Miner buffing device and draft gear, Edwards trap doors, Ajax diaphragms and curtains, Buhoup three-stem couplers, Westinghouse schedule PC brakes, National sash locks, Automatic ventilators, Standard Heat & Ventilation Company's Ideal heating system, Hale & Kilburn doors, Heywood Brothers & Wakefield seats and McCarthy continuous basket racks. The insulation is three-ply Salamander.

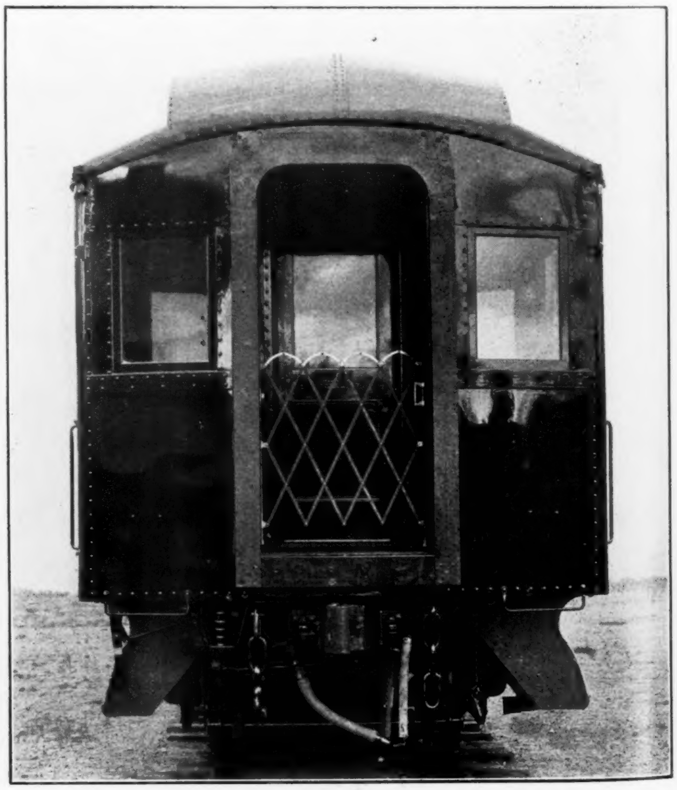
The cars are electrically lighted, the axle generator system

Interior of the New Haven Steel Coach

being used. There are six one-light center lamps and 24 one-light bracket lamps on the deck rail staggered over alternate seats with two one-light pendants in each vestibule.

The following are the principal dimensions and data:

Length over end sills .... 70 ft. 3½ in.
Length over buffer face plates .... 80 ft. 3¾ in.
Length inside .... 69 ft. 7¼ in.



End View of the New Haven Steel Coach

Width over side plates .... 9 ft. 11¼ in.
Width over lower deck eaves .... 10 ft. 0 in.
Width over upper deck eaves .... 6 ft. 4 in.
Width over platform steps .... 9 ft. 1 in.
Height, rail to lower deck eaves .... 10 ft. 11½ in.

Height, rail to upper deck eaves.............................13 ft. 2⅜ in.
Height, rail to top of roof.............................13 ft. 8¼ in.
Height, rail to top of platform.............................4 ft. 2 in.
Height, rail to top of body floor.............................4 ft. 3½ in.
Truck wheel base.............................10 ft. 6 in.
Distance center to center of trucks.............................54 ft. 3½ in.
Seating capacity.............................88
Total wheel base.............................64 ft. 9½ in.

BRAKE EFFICIENCY TESTS ON STEEL AND IRON WHEELS*

BY F. K. VIAL
Chief Engineer, Griffin Wheel Company, Chicago, Ill.

The coefficient of friction between the brake shoe and the moving wheel, which is the measure of brake efficiency, is a variable quantity depending on the speed and kind of wheel, the shoe pressure, the length of time the shoe is applied; the kind of shoe, whether plain, chilled or with inserts; the kind and shape of the inserts; the condition of the shoe, etc. The coefficients of friction for a large variety of brake shoes under varying conditions have been determined at Purdue University in a series of tests conducted for the M. C. B. Association and reported in the M. C. B. Proceedings for the year 1910-1911. Supplementary tests were also made for the Association of Manufacturers of Chilled Car Wheels.

For the original test, 14 pairs of brake shoes were selected, as indicated in Table I. One set of 14 shoes was tested at the laboratory of Purdue University, and the other set was tested on the brake shoe testing machine of the American Brake Shoe & Foundry Company at Mahwah, N. J. The coefficients of friction were determined on a chilled iron wheel in effecting stops from an initial speed of 40 m. p. h. under three brake shoe pressures, viz., 2,808, 4,152 and 6,840 lb. On the steel wheel the coefficients of friction were determined at pressures of 2,808, 4,152, 6,840, 10,000, 12,000, 15,000 and 18,000 lb., effecting stops from an initial speed of 65 m. p. h. The results are shown in Table I.

Table I.—Brake Shoe Friction Tests*

Test laboratory	Type of Brake Shoe	†Chilled iron wheel. Shoe pressure in pounds 2,808	4,152	6,840	Mean coefficient of friction in per cent.—Initial speed of 65 m. p. h. steel tired wheel. Shoe pressure in pounds 2,808	4,152	6,840	10,000	12,000	15,000	18,000
A. B. S. & F. Co.	Plain cast iron—(C. & N. W.)	26.3	21.7	21.0	16.3	13.1	11.0	....	....	....	....
Purdue	Plain cast iron—(C. & N. W.)	22.1	21.6	20.4	16.0	....	12.4	....	10.4	....	....
A. B. S. & F. Co.	Plain cast iron—(without re-inf.)	25.1	23.5	20.6	....	....	11.7	....	....	....	....
Purdue	Plain cast iron—(without re-inf.)	30.3	27.7	24.5	16.3	....	13.5	....	11.6	....	....
A. B. S. & F. Co.	Congdon—7 wrought ins'ts (C. & N. W.)	26.8	19.0	15.3	19.7	17.7	12.4	8.9	9.4	8.2	7.7
Purdue	Congdon—7 wrought ins'ts (C. & N. W.)	22.2	19.8	16.4	20.6	....	14.0	....	11.3	....	....
A. B. S. & F. Co.	Congdon—5 wrought ins'ts (A. B. S. & F.)	25.0	18.3	17.2	20.3	18.0	11.8	9.5	9.8	8.5	7.6
Purdue	Congdon—5 wrought ins'ts (A. B. S. & F.)	24.4	22.6	19.1	15.1	....	11.9	....	11.7	....	....
A. B. S. & F. Co.	Streeter—2 hard iron ins'ts (A. B. S. & F.)	24.5	22.6	19.0	16.9	14.9	11.2	11.7	10.4	9.5	9.1
Purdue	Streeter—2 hard iron ins'ts (A. B. S. & F.)	21.3	20.6	16.4	13.6	....	10.8	....	10.7	....	....
A. B. S. & F. Co.	Lappin—chilled ends (A. B. S. & F.)	18.2	16.8	16.1	15.0	13.4	10.1	8.8	8.6	8.8	6.8
Purdue	Lappin—chilled ends (A. B. S. & F.)	20.5	19.6	18.9	17.0	....	13.0	....	11.1	....	....
A. B. S. & F. Co.	Lappin—chilled ends (A. B. S. & F.)	20.5	18.4	14.3	16.3	15.1	11.6	9.1	9.3	7.9	6.6
Purdue	Lappin—chilled ends (A. B. S. & F.)	18.4	17.8	17.5	16.9	....	12.7	....	12.2	....	....
A. B. S. & F. Co.	Plain cast iron (A. B. S. & F.)	27.0	25.1	21.9	16.8	13.5	11.3	9.7	8.4	9.3	8.5
Purdue	Plain cast iron (A. B. S. & F.)	21.0	20.3	18.5	16.2	....	13.2	....	11.1	....	....
A. B. S. & F. Co.	Plain cast iron (Columbia B. S. Co.)	27.0	28.6	21.8	18.3	14.0	13.5	15.3	....	....	....
Purdue	Plain cast iron (Columbia B. S. Co.)	21.0	18.9	17.3	16.8	....	13.1	....	10.7	....	....
A. B. S. & F. Co.	Diamond S—chilled ends (A. B. S. & F.)	24.2	20.0	16.2	21.5	17.4	13.5	11.2	10.8	9.8	9.8
Purdue	Diamond S—chilled ends (A. B. S. & F.)	22.8	20.5	18.3	17.3	....	13.6	....	12.3	....	....
A. B. S. & F. Co.	Walsh—2 hard iron ins'ts (W. B. S. Co.)	22.6	20.0	14.9	14.7	12.1	10.3	8.7	8.6	9.1	8.7
Purdue	Walsh—2 hard iron ins'ts (W. B. S. Co.)	23.7	20.5	19.8	16.6	....	14.4	....	11.5	....	....
A. B. S. & F. Co.	Pittsburgh malleable iron shell	24.4	21.9	17.0	17.7	17.9	17.5	14.0	11.8	11.2	10.7
Purdue	Pittsburgh malleable iron shell	26.8	25.4	21.5	22.8	....	18.9	....	17.6	....	....
A. B. S. & F. Co.	Pittsburgh steel shell (P. B. S. Co.)	29.9	29.6	24.2	23.0	20.9	18.7	15.8	14.7	14.2	15.3
Purdue	Pittsburgh steel shell (P. B. S. Co.)	29.4	27.5	23.4	25.8	....	23.2	....	22.2	....	....
A. B. S. & F. Co.	National—chilled ends (N. B. S. Co.)	16.3	15.2	11.9	15.1	11.3	9.8	8.2	7.5	6.9	8.3
Purdue	National—chilled ends (N. B. S. Co.)	19.3	16.4	14.3	15.2	....	12.1	....	11.2	....	....

*Taken from the 1910 M. C. B. Proceedings. †Mean coefficient of friction in per cent.—Initial speed of 40 m. p. h.

The tests made at Purdue University, and reported in the M. C. B. Proceedings of 1911, were conducted on seven shoes effecting stops from 80 m. p. h. at pressures of 12,000, 14,000, 16,000, 18,000 and 20,000 lb., as shown in Table 2.

Table 2.—Purdue Tests for M. C. B. Association*

Coefficients of friction with a steel tired wheel—Initial speed 80 m. p. h.

Kind of Shoe	Shoe pressures in pounds 12,000	14,000	16,000	18,000	20,000
Congdon	9.60	9.08	8.68	8.57	7.25
Plain cast iron	8.22	9.22	9.19	8.70	7.21
Spear-Miller	9.98	9.47	8.42	7.67	8.30
National	8.73	8.99	8.67	7.68	6.87
Diamond S	9.72	9.55	8.73	8.86	7.02
U shoe	9.60	9.27	8.72	8.45	7.34
Pittsburgh	19.75	18.75	17.75	17.10	15.27

*Proceedings M. C. B. Association 1911.

A series of tests were also conducted for the Association of Manufacturers of Chilled Car Wheels at Purdue University, with brake shoes acting on both the chilled iron and steel wheel tested under pressures of 2,808, 4,152, 6,840 and 12,000 lb., from an initial speed of 40 m. p. h. The results of these tests are given in Table 3.

Table 3.—Purdue Tests for Association of Manufacturers of Chilled Car Wheels

Coefficients of friction from initial speed of 40 m. p. h.

Kind of Brake Shoe	Chilled iron — Pressures 2,808	4,152	6,840	12,000	Rolled steel wheels — Pressures 2,808	4,152	6,840	12,000
Streeter	24.7	20.8	17.6	13.8	21.4	18.7	14.7	12.8
Lappin chill. ends	18.5	16.5	14.8	13.6	18.5	16.2	13.2	11.4
Diamond S	22.5	20.0	18.4	14.8	19.8	16.5	14.0	11.7
V inserts, chilled inserts	17.4	17.0	11.8	10.9	19.3	16.9	13.9	12.8
Average	20.8	18.6	15.6	13.3	19.8	17.1	13.9	12.2

A review of the foregoing tests will show that a greater coefficient of friction is obtained with the chilled iron wheel. The number of brake shoes used in the various tests are different, therefore the averages are not exactly on the same basis. The results from the Diamond S shoe throughout seem to be very consistent. The tests made by Purdue University in 1910 show the Diamond S coefficients at the different pressures to be almost exactly equal to the average of all the shoes tested. Again in 1913, the shoes tested for the Association of Manufacturers of Chilled Car Wheels give the identical coefficients for the Diamond S shoe, and for that reason we know that the tests are comparative, although they were not all made at the same time. The results with this type of brake shoe are shown in Fig. 1. From this diagram, and from the review of the tables in general, the indications are very evident that there is a dropping off in the coefficient of friction in brake shoes, as the pressure increases. The rate of decrease amounts to about 6 per cent of the coefficient of friction for each increase of 1,000 lb. pressure. This 6 per cent drop is constant within the limits of these tests and holds

*This review was prepared for the Association of Manufacturers of Chilled Car Wheels, the data being obtained from a series of tests made for them at Purdue University during 1913.

true for both the chilled iron and steel wheels. This may be illustrated by the following data from the tests conducted by Purdue University for the Association of Manufacturers of Chilled Car Wheels:

	Chilled iron wheels		Steel wheels	
Pressure-pounds	Efficiency	Calculated Efficiency	Efficiency	Calculated Efficiency
3,000	22.	....	19.3	....
4,000	20.7	20.7	17.1	18.1
5,000	19.4	19.5	15.6	16.
6,000	18.4	18.3	14.5	14.6
7,000	17.6	17.3	13.7	13.6
8,000	16.9	16.6	13.1	12.8
9,000	16.3	15.9	12.6	12.3
10,000	15.8	15.4	12.2	11.8
11,000	15.3	14.9	11.9	11.4
12,000	14.8	14.4	11.7	11.1

While there are some departures from this 6 per cent reduction per 1,000 lb. addition to shoe pressure, these variations are compensating. In general the calculated values follow the observed values very closely.

It is also evident that there is a dropping off in the coefficient of friction as the velocity of the rotating wheel increases. It is, therefore, self evident that the retarding force is not proportional to the braking power or shoe pressure, but in general terms, for pressures between 2,000 and 15,000 lb. per shoe, the amount of work accomplished increases with but half the rapidity that the shoe pressure increases, that is to say, doubling the shoe pressure will increase the retarding effect 50 per cent. This is shown graphically in Fig. 2. At very low and very high pressures the work accomplished increases in a very much lower ratio. In the case of the Diamond S shoe on the chilled iron wheel, at a constant speed of 20 m. p. h., the coefficient of friction at 800 lb. pressure was 44 per cent, and at 2,000 lb. pressure, 26.3 per cent. This is shown graphically in Fig. 3. The retarding force at 800 lb. was 352 lb., while at 2,000 lb. pressure, the retarding force was 526 lb. This shows that for an increase in shoe pressure of 150 per cent, the work done increased but 50 per cent. This shows the great advantage of the small continuous pressure as compared with heavy intermittent pressure in controlling trains on heavy grades.

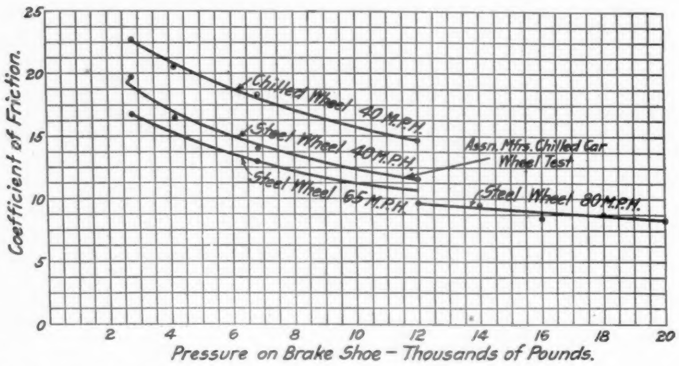


Fig. 1—Coefficient of Friction for Diamond S Brake Shoe in Stops from Various Initial Speeds

At very high pressures, Dean Benjamin of Purdue University states, in his report of May 10, 1911, to the chairman of the Brake Shoe Committee of the M. C. B. Association: "It is easily seen that the coefficients of friction drop rapidly between 18,000 and 20,000 lb. pressure, and that the amount of wear is correspondingly great while the stopping distance, of course, is not materially diminished."

RELATION OF SPEED TO COEFFICIENT OF FRICTION

On account of the majority of tests on the steel wheel having been made at high speeds and those on the chilled iron wheel at 40 m. p. h. and less, a direct comparison of the effect of speed on the coefficient of friction is not as clearly worked out as would be desirable. However, there is sufficient data to indicate the probable effect through a range of from 40 to 80 m. p. h. This is brought out in Fig. 1. Under heavier pressures the effect of speed is not as noticeable as at lower pressures. The probability is that after reaching 12,000 lb. pressure the speed effect is very largely eliminated, whereas at the lower pressures the effect of increasing speeds is a very material reduction in the coefficient of friction. There are two tests on steel wheels that may be compared. One of these was made with an initial speed of 40 m. p. h., the second with an initial speed of 65 m. p. h. From these tests it has been found that there is a drop of 10 per cent in brake efficiency in passing from 40 to 65 m. p. h. with steel wheels. There is no data at hand to show just what the variation is in the case of chilled wheels, but it is very probable that the loss in efficiency at higher speeds is very similar to that of steel wheels under like conditions.

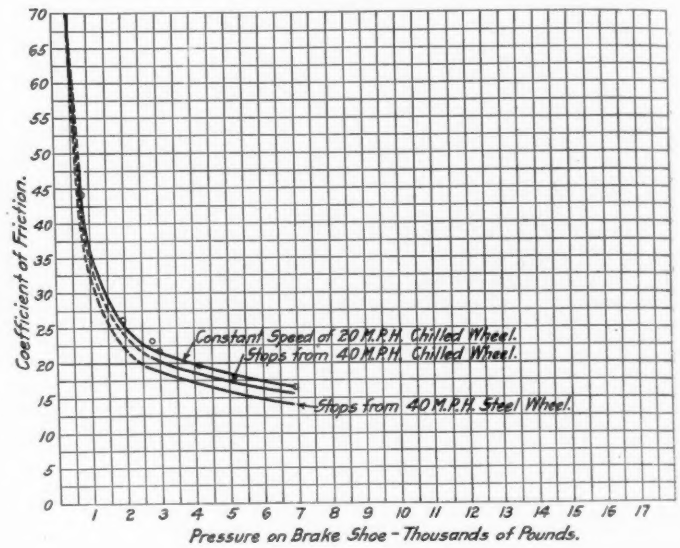


Fig. 2—Comparison of Coefficients of Friction in Stops from Initial Speed of 40 Miles per Hour and Uniform Speed of 20 Miles per Hour

BRAKE EFFICIENCY—CHILLED IRON VS. STEEL WHEELS

The question is often raised as to whether the brake efficiency of chilled iron wheels is equal to that of steel wheels.

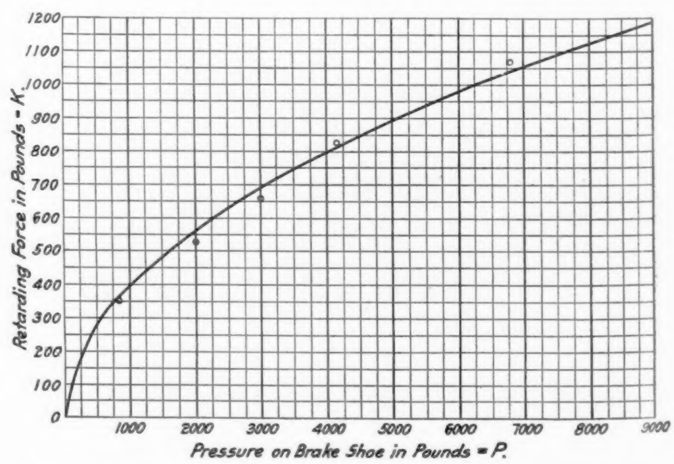


Fig. 3—Relation of Retarding Force to Pressure on Brake Shoe at 20 Miles per Hour

The indication is very strong in all the foregoing tests that not only is the brake efficiency of the chilled iron wheel equal to that of the steel wheel, but as a matter of fact, it is about 25 per cent higher. This is shown in comparing the tests made for the Association of Manufacturers of Chilled Car Wheels with the tests made for the M. C. B. Association.

stops being made from an initial speed of 40 m. p. h. According to Fig. 1 the coefficients of friction are easily 25 per cent in favor of the chilled iron wheel in stops made from an initial speed of 40 m. p. h. That the coefficient of friction between the brake shoe and the chilled iron wheel is materially greater than on the steel wheel, all conditions being equal, is clearly indicated in the M. C. B. Association specifications which state as follows:

	Coeff. of Friction Per cent.
First: Tests upon chilled iron wheel from an initial speed of 40 m. p. h.—	
at 2,808 lb. pressure	22
at 4,152 lb. pressure	20
at 6,840 lb. pressure	16
Second: Tests upon steel wheel from an initial speed of 65 m. p. h.—	
at 2,808 lb. pressure	16
at 4,152 lb. pressure	14
at 6,840 lb. pressure	12

Although the specifications required that the speed of the steel wheel be 65 m. p. h., and the chilled iron wheel 40 m. p. h., it does not seem that the difference on account of the speed element can amount to more than 10 per cent. Therefore, reducing the specifications for coefficients of friction on the steel wheel to 40 m. p. h. by the use of this factor, we have the following comparison of coefficients of friction on brake shoes for stops from an initial speed of 40 m. p. h. on both the chilled iron and steel wheel:

COEFFICIENT OF FRICTION

Pressure lb.	Chilled iron Per cent.	Steel wheel Per cent.	Difference	Per cent. in favor of chilled iron
2,808	22	17.6	4.4	25.
4,152	20	15.4	4.6	29.8
6,840	16	13.2	2.8	21.2

This indicates that the M. C. B. Association, in their specifications, demand 25 per cent greater efficiency in brake shoes when applied to chilled iron wheels than when applied to steel wheels. Applying these specifications to the tests made at Purdue University for the Association of Manufacturers of Chilled Car Wheels, we note that only two of the shoes fully met the specifications. These were the Streeter and Diamond S, which showed the following percentages in favor of the chilled iron wheel:

Streeter shoe:

At 2,808 lb. pres. retard. force 15.4 per cent. greater in chilled iron wheel
At 4,152 lb. pres. retard. force 11.2 per cent. greater in chilled iron wheel
At 6,840 lb. pres. retard. force 19.7 per cent. greater in chilled iron wheel
At 12,000 lb. pres. retard. force 7.8 per cent. greater in chilled iron wheel

Diamond S shoe:

At 2,808 lb. pres. retard. force 13.6 per cent. greater in chilled iron wheel
At 4,152 lb. pres. retard. force 21.2 per cent. greater in chilled iron wheel
At 6,840 lb. pres. retard. force 31.4 per cent. greater in chilled iron wheel
At 12,000 lb. pres. retard. force 26.5 per cent. greater in chilled iron wheel

In the report of Purdue University, signed by Lewis E. Endsley, addressed to the chairman of the M. C. B. Committee on Brake Shoe Tests, dated February 21, 1910, is found the following note concerning the tests:

"None of the 14 shoes tested damaged the surface of the cast iron wheel during the wearing test. In the wearing test on the steel tired wheel at a constant speed of 30 m. p. h. and at a pressure of 2,808 lb., two shoes scored the wheel.

"Shoe No. 286, which was given 300 applications, cut four V shaped grooves about 1/32 in. deep and several smaller ones in the surface of the wheel around the entire circumference. After test of this shoe, the wheel had to be ground with a revolving emery wheel in order to get a smooth surface for the next shoe.

"The other shoe that scored the steel tired wheel was No. 288. This shoe was given only 100 applications for in that time it had cut five grooves similar to those cut by shoe No. 286."

The foregoing shows that insert shoes cannot be used on steel wheels on account of the severe scoring and wearing away of the steel, whereas no such effect is found on the chilled iron wheel; and it will be found that the shoes with the steel inserts, which do the most damage to the steel wheels and, therefore, cannot be used, are the ones which give the high coefficient of friction and should be eliminated from consideration in making comparisons of laboratory tests. The final conclusion from all tests made at Purdue University is that the coefficient of brake shoe friction on chilled iron wheels is fully 25 per cent greater than on the steel wheels when working under ordinary conditions.

CAST IRON CAR WHEEL DESIGN

The paper presented by Prof. Louis Endsley at the March meeting of the Western Railway Club, on tests made at Purdue University, on the M. C. B. brake shoe testing machine, to determine the stress in the plate of cast iron wheels due to the heat produced by the brake shoe, contains much interesting and original information. Nine different wheels were tested as follows: M. C. B. standard 625 lb. wheel, M. C. B. standard 675 lb. wheel, M. C. B. standard 725 lb. wheel, 640 lb. wheel having an arch plate, 690 lb. wheel having an arch plate, 740 lb. wheel having an arch plate, 690 lb. wheel having a specially designed plate (this wheel has the same dimensions as the M. C. B. 625 lb. wheel, with the exception that the metal had been added to the plate of the wheel to make it weigh 690 lb.), and a 690 lb. wheel having a specially designed rim (this wheel has the same dimensions as the 625 lb. M. C. B. wheel, with the exception that the metal was added to its rim to bring the weight up to 690 lb.).

The purpose of the test was to determine the stress in the plate of the wheel under different conditions of braking. The wheels were run at speeds of various magnitudes and the pressures of the shoe on the wheel were 800 lb., 2,808 lb., 4,152 lb. and 6,840 lb. The method of obtaining the stress in the plate was rather unique. Prof. Endsley used the Berry strain gage, which measures the elongation between two points two inches apart, with an accuracy within one ten-thousandth of an inch. It was believed that the plate would be under severe strain, due to the heat expanding the rim of the wheel. This was found to be the case.

A piece of car wheel iron was first tested on a tension testing machine to determine the amount of stress per unit of elongation. The results thus obtained were used to interpret the readings of the Berry strain gage. The necessary correction for the expansion of the metal at the point of reading was obtained by placing a thermometer at the point in the plate of the wheel where the reading was taken. This correction was deducted from the reading of the strain gage, the difference being the elongation due to the pulling of the rim of the wheel on the gage.

It was found that the stress in the plate for any given wheel is nearly proportional to the difference in temperature between the hub and rim. This held true whether the rim temperature was high or low, the difference in the temperature being the controlling factor. For any given test this difference in temperature becomes a constant, and after it has become constant the stresses also remain constant. It was found that the maximum stress of the plate in wheels working with a brake shoe at a continuous pressure was the same as when the intermittent pressure was applied, if the work in both cases amounted to the same ultimate total. The factor that affects this stress the most is the design of the wheel. The stress was found to vary from 12,000 lb. in the 840 lb. arch plate wheel to 20,000 lb. in the M. C. B. standard 675 lb. wheel. It was also found that the three arch plate wheels had a much lower stress than the standard M. C. B. wheels, which would indicate that the reverse curve in the plate of the standard M. C. B. wheels was of no real benefit and that a plate with a smooth curve of large radius would give much more satisfactory results.

GOLD IN RUSSIA.—According to official statistics, there were, in 1912, in the Orenburg mining district 303 gold-washing concerns, of which, however, only 58 were in operation.—*Engineering.*

STEEL ENDS FOR BOX CARS*

BY W. A. McGEE

Chief Draftsman, Lake Shore & Michigan Southern, Cleveland, Ohio

As all car builders and designers know, two great points of weakness have developed in the construction of wooden box cars; the first is the underframe and the second is the end. While much has been done to overcome the weakness of the underframes by constructing them of steel, little has been done to overcome the weakness of the ends.

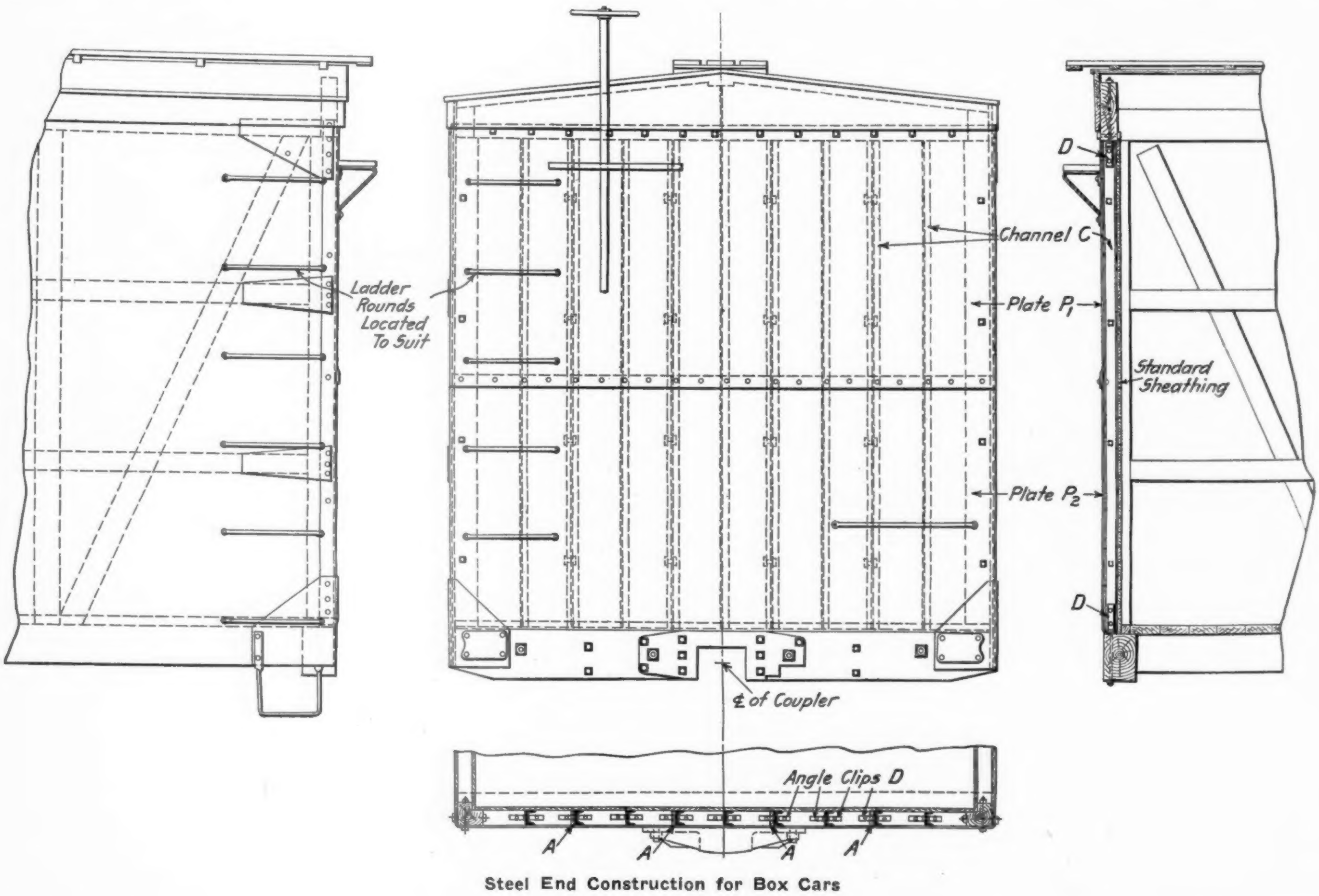
The accompanying illustration shows an end constructed of

Kind and construction of end	Safe load uniformly distributed over entire surface	Total weight	Increased strength of steel over wooden end	Uniform load in pounds per pound weight of end
Wood, with oak posts and malleable iron pockets	7,500 lb.	1,050 lb.	....	7.15
Steel, with 3/16 in. plate reinforced with nine 3 in., 4 lb. channels	13,000 lb.	1,300 lb.	73%	10
Steel, with 3/16 plate on top section and ¼ in. plate on bottom section, reinforced with nine 3 in., 5.5 lb. I-beams	20,000 lb.	1,630 lb.	166%	12.2
Steel, with 3/16 in. plate on top section and ¼ in. plate on bottom section, reinforced with nine 4 in., 5.25 lb. channels	23,000 lb.	1,730 lb.	206%	13.3
Steel, with 3/16 in. plate on top section and ¼ in. plate on bottom section, reinforced with nine 4 in., 7.5 lb. I-beams	32,000 lb.	1,800 lb.	326%	17.75

steel plate and standard rolled steel shapes, which to a great extent overcomes the weakness of the wooden end. It is composed of steel plates P_1 and P_2, reinforced with rolled steel beams or channels C to which wooden sleepers A are bolted for the purpose of nailing on the inside sheathing. The reinforcing beams are held by means of angle clips D, which are bolted through the end plate and end sill of the car.

The use of this end increases the strength of the car and prevents bulging or breaking due to the shifting of the load. It requires no special dies or bending machines in manufacture, and quick repairs can be made on account of the parts being made of standard rolled material which can be readily obtained from stock. It can be made any desired strength, depending on conditions and the capacity of the car. For box cars of 40,000 lb. to 50,000 lb. capacity it should be made of 3/16 in. plate, reinforced with 3 in. channels or I beams; for box cars of 60,000 lb. capacity or over, of 3/16 in. plate on the top section and ¼ in. plate on the bottom section, reinforced with 4 in. channels or I beams.

The accompanying table shows the comparative strength, weights, etc., of the steel and wooden ends.



Steel End Construction for Box Cars

*Entered in the Car Department Competition which closed February 1, 1914.

Gold Placers in Alaska.—Since mining began in Alaska in 1880 the gold placers of the territory have yielded 7,488,491 fine ounces of gold, valued at $154,800,875.

Ohio Mine Rescue Car.—John C. Davis, chief inspector of mines for the state of Ohio, has designed a rescue car, the interior arrangement of which is somewhat different from other rescue cars. In planning this car the designer kept in mind that it was to be used in emergency cases, and eliminated those features which had no direct bearing upon its objective use. There is a living room for one man; no more toilets are to be installed than are absolutely necessary, thus saving room which will be used for the hospital, and other practical features. The car is to be equipped with safety apparatus, hospital arrangement, and first-aid supplies, and it will be stationed at Columbus and kept in readiness to be sent to the place of disaster as soon as notice is received.—*The Colliery Engineer.*

SHOP PRACTICE

LOCOMOTIVE MILEAGE AND REPAIR RECORDS ON THE CANADIAN PACIFIC

In arriving at the amount of money which should be spent in repairing locomotives on the Canadian Pacific, a system has been adopted using a definite allowance per mile between shoppings. This allowance varies directly with the hauling power, and in the case of a 100 per cent engine (20,000 lb. tractive effort) is 2.5 cents per mile on the Eastern Lines. A slightly higher figure is used for the Western Lines owing to the higher rates of wages in force there.

This rate per mile is not by any means an arbitrary figure, but has been determined on after careful study of all the factors involved, and from a study of the costs shown by the records for a number of years previous to the adoption of this method.

Taking the case of a 100 per cent engine that has made 75,000 miles, there would be available $1,875 for repairs. This has been determined, as indicated above, to be a fair average amount to be spent for repairs on that class of locomotive after a mileage of 75,000. If, because of some exceptional conditions under which the engine has been working, or some extraordinarily heavy repairs found necessary after the engine is in the shop, it becomes necessary to spend $2,000, it is an indication that either the previous repairs were not thorough enough to permit of the engine making its mileage allowance or that the running repairs had been neglected in the roundhouse.

This is called to the attention of the master mechanic under whose supervision the engine was, and provides him with a means of locating weak spots in his organization.

After the general repairs (No. 1) the engine starts again with a clean record. If it is later found necessary to shop the engine for any cause, either light general repairs, classified as No. 2, or specific repairs, classified as No. 3, the amount available would, of course, be the mileage made to date multiplied by the rate. When the engine has later made the full mileage and is shopped again for general overhauling, the amount spent on the intermediate repairs is deducted from the total which would otherwise be available.

For example, considering the same engine as previously, if the mileage up to the time of the intermediate repairs was 30,000, the amount available would be $750. It might, however, be necessary to spend $1,000, in which case the total amount spent on the intermediate repairs would be held as a charge against the engine at the time of the next general overhauling, thus cutting down the amount available.

For example, if the engine made 45,000 miles after the intermediate repairs, the amount available would be $75{,}000 \times 2.5 =$ $\$1{,}875 - \$1{,}000 = \$875$. It would, of course, hardly be possible to give the engine a general overhauling for this amount, and the overdraw in this case would show against the division master mechanic's record.

To prevent this, the master mechanic would, after the intermediate repairs, endeavor to run the engine as long as possible in order to get as much more mileage as possible, so that when next stopped for overhauling as large an amount as could be obtained would be credited to the engine.

The object of keeping a separate account of each engine in this way is to distinguish between those engines which cost more and those which cost less than the average, and thus enable the division master mechanic to keep in close touch with what each engine is doing, and to check up the roundhouse foreman who is neglecting the maintenance of his engines. The charges are used entirely for this purpose, as each engine is, of course, thoroughly repaired regardless of the mileage charges against it. It will readily be seen, however, that the system forms an excellent means of keeping track of the records of both locomotives and mechanical department officers.

The mileage allowance between shoppings is based on peculiarities of the particular type and design of locomotive, and on the modern power varies from 75,000 to 125,000.

FIREBOX RIVETING

BY N. H. AHSIUOLH

The fitting and riveting of tube sheets and side sheets in wide fireboxes, as locomotives go through the shops for repairs, are among the heaviest jobs encountered by boilermakers. Various methods of fitting the sheets and driving the rivets are employed, but those described in this article have been successfully used by the author for the past ten years.

The tube sheets are laid out and punched, and the flanges are scarfed from the center of the rivet holes to one-half the original

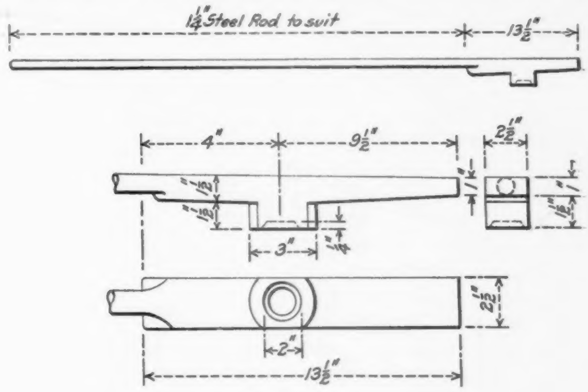


Fig. 1

thickness at the edge of the lap. A 1 1/16 in. lap is allowed from the center line of the rivet holes for ¾ in. rivets. The flange holes are then countersunk and the sheet is bolted in place in the firebox, using temporary bolts in every third hole all around the flange. The crown sheet is heated and laid in place on the flue sheet flange; the top corners, the side flanges and the mudring corners are then heated and fitted up tight. A 9 in. stroke

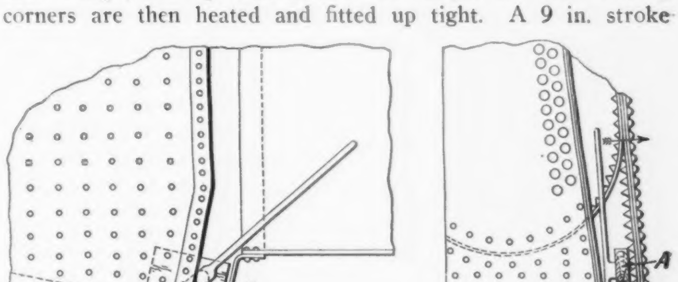


Fig. 2

riveting hammer and a flat die are used to drive the rivets, while a small air hammer and bob tool are used to finish and caulk them. One boilermaker, one helper and a rivet boy generally drive all the rivets in the tube sheet flanges, in from six to eight hours.

Fig. 1 illustrates the type of holding on bar used on the water

leg rivets on the sides of the tube sheet. The heel of this bar is cupped out ¼ in. deep as shown to prevent its slipping off the head of the rivet. The bar is placed as shown in Fig. 2, with the end on the bottom water leg rivet, which is the first one applied. A wooden block, *A*, of a thickness to suit, is then placed in the position shown. A hot rivet is placed in the hole, the bar is placed against the rivet, and pressure is exerted by the helper against the end of the bar in the direction indicated by the arrow. In this instance the heel of the holding on bar acts as the fulcrum, the rivet head as the load, and the pressure exerted on the end of the bar as the weight.

Enough succeeding rivets are held on in this manner, going upward along the flange, until the bar can be turned as shown in Fig. 3 and the heel used to hold the rivets. Bolts *B* are inserted through staybolt holes in the side sheets for the block to rest upon; the bar is turned and the pressure is exerted in the direction of the arrow.

As the riveting progresses upward on the side flanges, the bar

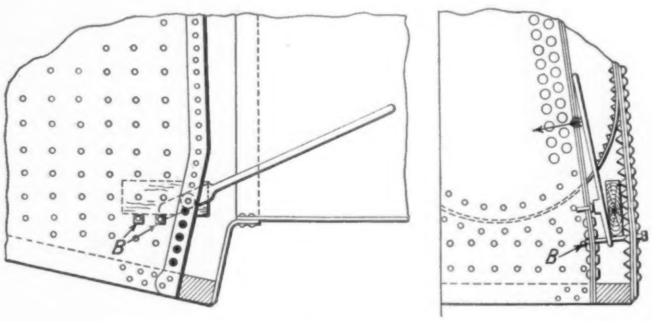


Fig. 3

assumes a more horizontal position as in Fig. 4. The angle iron *C* is now bolted to the flue sheet, and the rivets held on as shown until the top corners are reached. Across the top flange an ordinary holding on sledge is used with a countersink to receive the rivet head.

As these sheets are fitted up perfectly before any riveting is done, there is no slack; therefore starting the riveting at the bottom does not make any difference. On account of the flanges being scarfed, and also as all rivets are caulked as soon as driven, while the holding on bar is still on the rivet, it has never been considered necessary to caulk the seams. Tube sheets applied in this manner have run three years and have never been caulked

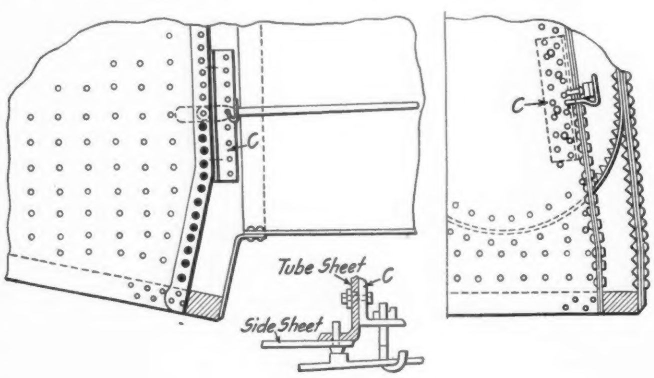


Fig. 4

either on the fire or water side. The only leaks ever noticed were during the hydrostatic test after applying the second set of tubes, when the top edge along the crown sheet would be slightly sprung but not enough to require caulking.

After the water space rivets are finished the mudring rivets are applied, using two riveting hammers, holding on the outside with a button die and driving inside on the new sheet, using a flat die. The corner rivets are driven in the same manner, except that the holes inside have a deeper countersink. These sheets have 103 flange rivets and 54 mudring rivets. All riveting is generally completed in one day of 10 hours by one boilermaker, one helper and a rivet boy. This can be considered a good performance when the extra work necessary to get the sheets absolutely iron to iron, to avoid the necessity of caulking the seams, is taken into consideration.

In applying side sheets, the sheets are laid out, the top seam is scarfed as in the case of the tube sheets, and 1 1/16 in. lap is allowed for ¾ in. rivets. After the machine work of countersinking the rivet holes is done, the sheet is applied to the firebox, placing temporary bolts in every third hole and laying up the laps thoroughly. The holding on bar shown in Fig. 1 is used with

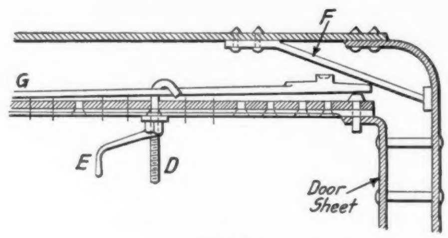


Fig. 5.

an extra long handle to enable the helper to stand in the barrel of the boiler. This bar is placed in position as in Fig. 5, using the hook *D* for a support. This hook is made with the least possible amount of bend at the end, to enable a workman driving rivets on the firebox side to change the hook from one hole to another; the helper meanwhile guides the bar. The threaded nut has a handle *E* to facilitate the work, doing away with the necessity of handling any wrenches. Where the backhead braces, as at *F* Fig. 5, are too close to the door sheet flange, the holding on bar is turned as shown. Rivets are held in this manner until the bar can be turned over and the heel placed on the rivet heads, as in Fig. 6.

To apply a rivet to a hole, the handle *E* is turned backward to loosen the hook, and the bar is pulled forward to provide room to enter the rivet. The helper then places the rivet in the hole, using long spring tongs; in this he is assisted by the boiler-

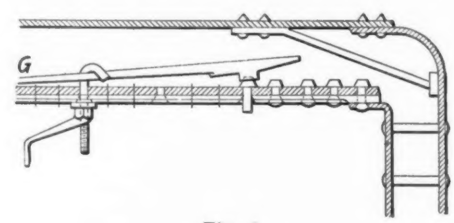


Fig. 6

maker, using a hook inserted in the next rivet hole or in a staybolt hole, as is most convenient. After the rivet is in the hole, the holding on bar is placed on the head by the helper; the boilermaker in the firebox meanwhile tightens the nut of the hook until the bar rests on the sheet at *G* and is also hard against the rivet head. This puts a spring in the bar, causing the rivet head to draw up tight as the boilermaker drives and caulks it. There is very little work necessary for the helper except to guide the bar on the rivet, as the real work of holding on is done by the spring in the bar. The hook is used until within six or eight rivets from the tube sheet flange, when the angle iron is used, as in Fig. 4, to hold the balance of the rivets in the side sheet seam.

To drive the rivets down the door sheet flange, the side sheet is wedged out slightly at the bottom and the holding on bar and hook are used in the same manner as on the side sheet, except that the bar is at an angle of 45 deg. with the seam, instead of in line. The side sheet seams are never caulked.

This method of holding on rivets has many advantages over some of the other methods of using wedges and cups to suit various water spaces, requiring an extra helper to use the sledge on the wedge bars.

Inspection and Work Schedules

A Combined System for Locomotives That Is in Successful Use on the Canadian Pacific

The Canadian Pacific has in use at the Angus shops, Montreal, a combined system of inspection and work schedules which covers the operations on the locomotive from the time it arrives from the road for repairs till the repairs are completed. The system has been carefully worked out and is giving excellent results. The work of actually arranging the work schedules is taken care

CANADIAN PACIFIC RAILWAY COMPANY.
MOTIVE POWER DEPARTMENT.
REPORT OF REPAIRS TO BE MADE IN
EAST MACHINE SHOP.

Eng. No. ____
Class ____
Rep. No. ____

Wheels ____

Boxes ____

Eng. Truck ____

Idlers ____

Crossheads ____

Fig. 1—Work Report to be Prepared from the Inspector's Report

of by a chief schedule man and three assistants, one for each of the two machine shops and one for the erecting shop.

Inspection

Immediately after an engine arrives at the shop for repairs it is looked over by an inspector in the yard. This inspection is only preliminary and is mainly for the purpose of determining what heavy parts, which would have to be ordered from the iron or steel foundries, or on which considerable machine work is required, are missing or broken and will have to be renewed. Orders are at once placed for renewals for these parts and work is started on them so that when the locomotive is taken in the shop and the repair work is begun, they are well under way, or may even be finished and ready for application. The possibilities of saving by this practice will readily be seen, and the time required by an inspector to determine what parts should be ordered in advance, is small.

12 M R 3.

Issue to a. b. e.

CANADIAN PACIFIC RAILWAY
ALL LINES.
MOTIVE POWER DEPARTMENT.

MAINTENANCE REGULATION 12 M R 3.
ENGINE TRUCK AXLES, LIMITS OF WEAR.
ISSUE NO. 3. AUGUST 2, 1911.

1. Engine truck axles of original diameters shown under column "Diameter of Journals" should be removed from under engine when below limit diameters given according to the type of truck. Such axles are to be replaced with axles of standard size, and, if the removed axles are in good condition they may be used for a smaller engine, otherwise they shall be scrapped.
2. Axles of engines receiving No. 1 or No. 2 repairs if found 1-16" hollow or taper, or 1-32" out of round, or if necessary from other cause, are to be trued on their centers, leaving a witness mark to show that no unnecessary metal has been removed.

Diameter of Journal.	LIMIT DIAMETERS.				
	TWO WHEEL TRUCKS.	FOUR WHEEL TRUCKS.		TRAILING TRUCKS.	COLLAR
		4-4-0 LOCOS.	4-6-0 & 4-6-2 LOCOS.		LIMIT.
4 1-2"		4 1-4"			
5"	4 5-8"	4 5-8"	4 5-8"		
6"	5 5-8"	5 5-8"	5 5-8"		
7"				6 5-8"	5-8"
8 1-2"				8 1-8"	

Fig. 2—Limits of Wear for Engine Truck Axles

A great deal can also be learned as to the locomotive's condition and what repairs are necessary by a careful examination of the repair reports furnished by the foreman and master mechanic in whose charge the engine has been while in service, and the inspector uses them as a guide in making his own inspection. The inspector makes his detailed examination after the engine is taken in the shop, and fills out a general inspection report. This inspection is begun before the work of stripping and continues with it. From this inspection report there is filled out a form such as that shown in Fig. 1, for each shop, covering the work necessary in each department. Orders for any further parts, which for good reasons may not have been discovered during the preliminary inspection in the yard, are then made out, as will be referred to later.

Standard maintenance regulations have been developed covering limits of wear on certain parts, such as piston rods and axles. These regulations are arranged in card form, as shown in Fig. 2, and the shop inspectors are governed by them wherever they apply. An axle or crank pin is not removed and replaced unless its condition requires it as indicated by reference to the limits provided in these cards. The limits of wear have,

99 M R 2.

Issue to a. d. c. e.

CANADIAN PACIFIC RAILWAY
ALL LINES.
MOTIVE POWER DEPARTMENT.

MAINTENANCE REGULATION 99 M R 2.
CLASSIFICATION OF LOCOMOTIVE REPAIRS.
ISSUE NO. 3. JULY 20, 1910.

1. Repairs to locomotives to be sub-divided as follows:-
   Wreck repairs.
   Defect repairs.
   Running repairs.
   Shop repairs.
2. Wreck repairs to be designated by the letter "W", are those due to accidents and collisions and do not include the cost of replacing defective portions of the engine unless connected with accident or wreck.
3. Defect repairs, to be designated by the letter "D", are those necessitated in replacing broken or defective parts when not accompanied by wreck or accident.
4. Running repairs, to be designated by letter "R", are repairs other than wreck or defect on which the estimated cost of labor at one shopping does not exceed $ 100.00. If tires are changed or turned when engine receives running repairs they will be designated as R. T.
5. Shop repairs, to be designated by specific numbers, are repairs other than wreck or defect, on which the estimated cost of labor exceeds $100.00.
   Shop repairs are designated by number according to the amount of work done 1st. on machinery, 2nd. on tubes, 3rd. on firebox as follows:-
   Machinery Repairs No. 1 General repairs to machinery with tires turned or changed.
   No. 2 Light repairs to machinery with tires turned or changed.
   No. 3 Light repairs to machinery with tires not turned or changed.
   Tube Repairs. No. 1 Tubes removed and reset.
   No. 2 Tubes part removed and reset; if less than 10 per cent of tubes are removed it shall not be considered a repair.
   Firebox Repairs. Are specified by number of sheets applied: two half sides equal one sheet
   Conversions or Rebuilds. C. When converted from one type to another.
   B. When receiving new boilers without conversion.
   B. C. When receiving new boilers and converted.
6. Form M. P. 19 to be made out for R. T. and Form M. P. 18 and 19 for all other shop repairs.

Fig. 3—Classification of Locomotive Repairs

of course, been determined upon strictly in accordance with safe practice, and in all cases the recognized stresses have been adhered to and scrapping limits arrived at by the use of safe working stresses.

In times of depression in business, considerable savings in repair expenses can be made by carefully noting the locomotive's condition and removing and distributing to the machine shop only such parts as absolutely require it. This does not mean, however, that each engine is not thoroughly repaired whenever it is necessary.

Arrangement of the Work Schedule

The method of classifying the repairs for locomotives is shown in Fig. 3 and is standard over the whole road. No. 1 repairs have an 18 day schedule and consist of general repairs to the machinery, but no heavy boiler work. If heavy boiler work is required the repairs are still classified as No. 1, but extra time is allowed and the repairs are then classified as an MIFI, F2, F3 or F4 (or, omitting the letters, 1, 1, or 1, 2) the second numeral indicating the number of firebox sheets to be renewed.

Tube renewals, in part or for a complete set, are shown by adding T1 or T2.

No. 2 repairs have a 14 day schedule and consist of light repairs to the machinery and tire turning. However, in case of

Fig. 4—Stencil on a Locomotive Indicating No. 1 Machinery and Tube Repairs and the Renewal of Four Firebox Sheets

the failure of any sheet in the firebox, either from a scorched crown or other defect, the engine would then receive repairs classified as M2, F1, F2 or F3 as the case might be.

No. 3 repairs cover some specific damage or defect and re-

ANGUS SHOPS.

ENGINE OUTPUT.

No. 1 Date in	No. 2 Date in	Date out	Day	Gang #1	Gang #2	Gang #3	Gang #4	Gang #5	New Engs.
Feb. 17	Feb. 21	Mar. 9	Monday	2778			7312		
18	23	10	Tuesday		840			3381	2661
19	24	11	Wednesday			3476			
20	25	12	Thursday	6125			2513	3503	
21	26	13	Friday		2113			650	2662
23	27	14	Saturday			778			
24	28	16	Monday	531			892		
25	Mar. 2	17	Tuesday		997				2663
26	3	18	Wednesday			999			
27	4	19	Thursday	6214			2750		
28	5	20	Friday		3040				2664
Mar. 2	6	21	Saturday			6051			
3	7	23	Monday	2226			1014		
4	9	24	Tuesday		3382				2665
5	10	25	Wednesday			2005			
6	11	26	Thursday	998			2225		
7	12	27	Friday		2052				
9	13	28	Saturday			3033			
10	14	30	Monday	3510			2604		
11	16	31	Tuesday		3387				
12	17	Apr. 1	Wednesday			3291			
13	18	2	Thursday	2205			3939		
14	19	3	Friday		3477				
16	20	4	Saturday			540			
17	21	6	Monday						
18	23	7	Tuesday						
19	24	8	Wednesday						
20	25	9	Thursday						
21	26	10	Friday						
23	27	11	Saturday						

Fig. 5—Division of Work Among the Various Gangs

quire a special time schedule in each case. The class of repairs, with other information pertaining to them, is stenciled on the smoke box of each locomotive as shown in Fig. 4.

Each week the superintendent of shops prepares a list of the engines to be shopped during that week, preference being given to any particular class of power that may be required. From this list is prepared the sheet shown in Fig. 5, dividing the work among the gang foremen in the erecting shop according to conditions. This is revised weekly. In the two left hand columns are given the dates on which 18 and 14 day repairs must com-

SCHEDULF FOR NO 1 REPAIR

Days in Shop	Erecting Shop	Boiler Shop	Smith Shop	Machine Shops: Brass Shop	East Machine	West Machine	Spring and Brake	Tank Shop	Tender and Carpenters' Shop	Paint Shop	Days in Shop
1	Off wheels stripped for test. Grates out, smoke box door and netting off. Inspector's complete report in.										1
2	Stripping completed. Steam and exhaust pipes out.	Stavbolts tested.						Ashpan down			2
3	New parts ordered. All smaller parts delivered, also frames and splices requiring repair. Cylinder and valve bushings out. Headers out.	2 in. tubes out.									3
4	Boiler to boiler shop, or boiler work started.										4
5	Cylinders off (if new ones required)	5 in. tubes out	Frames, splices and tail bar finished. Tender springs and brake gears.								5
6		5 in. tubes cut and rumbled.	Links, main and side rods and straps, and cross stays finished.				Tender spring and brake gear finished.				6
7		2 in. tubes welded 5 in. tubes to smith shop	Motion work finished. Spring gear finished.			Guide bar sizes to East Machine Shop					7
8	Valve seats faced. Cylinder patched				Frames. Bottom splices. Cylinder deck castings. Tail bars. Connection castings. Crossties. Expansion brackets. Turret valves.	Reverse lever fulcrums.		Tender stripped. Tank lifted for repairs.	Tender trucks stripped and wheels delivered to Machine Shop		8
9	Back covers ground in. Cylinder and valve bushings in and bored. Frames and cylinders bolted together. Width furnished. Binders up.	5 in. tubes cut and tested	Brake gear finished. Engine springs finished		Cylinder and valve bushings finished. Back cylinder covers finished. Top splices, frame fillings, shoes and wedges and runboard bracket (wrought iron). Box sizes to erecting shop.	Motion plates and crossties. Crosshead arms. Guide yoke knees.	Runboard brackets (cast steel)				9
10	Shoes and wedges laid off	Firebox work finished. Tubes	Tender springs and brake gear finished.	Boiler mountings, including pressure gages, finished	Crosshead (Stephenson) buffer casting or angles. Back valve covers. Steam chests. Superheater headers delivered to steamfitters.	Guide bars finished. Dry pipe, dome pot and stand pipe. Eccentrics finished. Pillars and fillers. Tee pipes.	Damper cylinder brackets.	Expansion and waist sheets. Feed pipe clips.			10
11	Guides and crossheads finished. Boiler set.	Boiler tested		Damper cylinder finished.	Crossheads (Walschaert) Center casting. Driving wheels.	Motion and valves finished.	Brake cylinder plates. Grate shaker lever brackets. Springs and gear	Tank and frame finished. Cab support plates. Runboards.			11
12	Motion hung. Overhung brake gear up. Engine wheeled. Buffer beam up. Shoes and wedges finished.				Front cylinder and valve covers. Ashpan hoppers. Idler pedestals. Pistons (Walschaert). Sandboxes. Truck brake gear	Bell stands finished.	Superheater damper gear.	Cab finished. Buffer beam ready	Cab woodwork finished. Trucks finished and tender trucked		12
13	Headers in. Boiler lagged.		Diagonal stays finished.	Injectors finished	Steam pipes. Smokestack bases.	Main rods finished.	Ashpan gear. Brake gear. Pump brackets. Reservoir bands.		Tender finished	Boiler painted. Tender finished.	13
14	Motion and valves finished. Main rods up. Headers tested. Buffer beam up.		Pilot stays finished. Dynamo brackets finished.	Air brake work, metallic packing, relief and by-pass valves and cylinder cocks finished.	Exhaust pipes. Radial truck stay plates. Smokebox fronts. Smokestacks. Main equalizer fulcrum casting.	Cylinder cock gear. Main rod safety hangers.	Coupler castings. Damper cylinder. Firedoor. Grate shaker gear. Whistle rigging.	Ashpan. Draft pipe and hangers. Lamp board and brackets			14
15	Valves set. Brake gear up. Steam and exhaust pipes in. Pipe work finished.				Engine truck and idlers. Cylinder and valve casings. Friction casting. Piston (Stephenson). Pilot and diagonal stays. Steam chest covers (flat valves)	Side rods finished.	Main truck equalizers.	Ashpan deflectors			15
16	Engine trucked. Rods on. Plates and netting in										16
17	Clipping and light work finished. Air tested and grate bars in							Tender taken into Erecting Shop, coupled up and brake tested		Engine finished	17
18	Pops set. Engine on trial.										18

Fig. 6—Shop Schedule for No. 1 Repairs

mence in order to be completed on the day given in the column headed Date Out.

Having obtained definite information as to the work necessary to be done on the engine, and also the outgoing date from Fig.

5, it is now possible to lay out a time schedule for the entire work in the different departments of the shop. This schedule is based on the master schedules shown in Figs. 6 and 7, and is varied slightly to suit different types of engines. When it is desired to limit the shop expenditure to a certain amount, a careful selection of engines is made, shopping only those requiring No. 1 or straight machinery repairs without firebox work, under which conditions a very accurate estimate can be made.

SCHEDULE FOR NO. 2 REPAIR

Days in Shop	Erecting Shop	Boiler Shop	Smith Shop	Machine Shops: Brass Shop	Machine Shops: East Machining	Machine Shops: West Machining	Machine Shops: Spring and Brake	Tank Shop	Tender and Carpenters' Shop	Paint Shop	Days in Shop
1	Off wheels and stripped for test. Grates out. Smoke box door and netting off. Inspector's report in.										1
2	Stripping completed. Steam and exhaust pipes out.	Staybolts tested						Ashpan down			2
3	New parts ordered. All repair material delivered. Headers out. Cylinder and valve bushings out. Cylinders off (if new ones required).	Boiler work started. 2 in. tubes out									3
4											4
5		5 in. tubes out	Motion work finished. Frames and splices. Tail bar								5
6			Spring and brake gear finished.					Tender stripped. Tank lifted for repairs.	Tender trucks stripped. Wheels delivered to Machine Shop.		6
7	Valve seats faced. Cylinder patched.	2 in. tubes welded. 5 in. tubes cut and rumbled		Turret valves	Frames. Cylinders. Tail bars. Expansion brackets. Deck casting. Waist sheet cross-tie. Frame stay. Connection casting.	Reverse lever fulcrum					7
8	Frames up. Cylinders set. Deck casting in. Widths furnished. Binders up			Boiler mountings.	Box sizes to Erecting Shop. Cylinder and valve bushings. Back cylinder heads. Guard stays. Top splices. Runboard brackets. Shoes and wedges. Frame fillings. Runboard brackets (wrought iron)	Motion plate. Guide yoke knees. Motion crosstie	Runboard brackets (cast steel)				8
9	Shoes and wedges laid off. Boiler set. Motion plate up. Expansion and waist sheets up	5 in. tubes cut and tested. Tubes in boiler. Boiler tested		Throttle stuffing box. Top checks	Buffer castings or angles. Crossheads (Stephenson). Steam chest. Back valve covers. Superheater headers delivered to steamfitters.	Back valve covers (with hanger brackets cast on). Dome pot. Dry pipe. Eccentrics. Motion. Valves. Pillars and fillers. Stand pipes. Tee pipes. Guide bars. Throttle. Rod ends.	Damper cylinder brackets. Brake cylinder plates. Grate shaker lever brackets	Tank and frame finished. Expansion and waist sheets ready. Buffer beam. Feed pipe clips			9
10	Guides and crossheads lined up. Motion hung. Buffer beam up				Ashpan hoppers. Center casting. Front cylinder and valve covers. Sand box. Idler pedestals. Driving wheels. Truck brake gear. Cross heads (Walschaert). Pistons (Walschaert).	Bell stand.	Springs and gear. Superheater damper gear	Cab plates ready. Runboards ready. Dry pipe. Deflector plates.	Trucks finished and tender trucked. Buffer beam. Runboards		10
11	Spring gear up. Engine wheeled. Motion finished. Headers in. Boiler lagged.		Dynamo brackets to Erecting Shop	Damper cylinders. Relief and by-pass valves	Exhaust pipe. Radial truck stays and plates. Steam pipes. Smokestack base. Smokebox front. Main equalizer. Fulcrum casting.	Cylinder cock gear. Main rods. Main rod safety hangers	Whistle rigging. Coupler casting. Brake gear. Pump brackets. Ashpan gear. Reservoir bands. Fire doors. Grate shaker gear	Cab ready. Ashpan ready. Draft pipe and hangers. Lamp board and brackets	Tender finished. Pilot finished	Tender painted	1
12	Valves set. Brake gear up. Headers tested. Steam and exhaust pipes in		Cab handrails. Pin lifter. Pilot stays.	Number plate. Class plate.	Pistons (Stephenson). Friction gear. Cylinder and valve casings. Engine truck and idlers. Pilot and diagonal stays.	Side rods	Main truck equalizers	Ashpan deflectors		Boiler painted	12
13	Plates and netting in. Rods on. Engine trucked. Clipping finished							Tender taken into Erecting Shop, coupled up and brake tested.		Engine painted	13
14	Engine on trial										14

Fig. 7—Shop Schedule for No. 2 Repairs

The master schedules give the day, based on the date that the engine is brought in the shop, on which each part of the work should be completed, and from them are prepared typewritten sheets like that shown in Fig. 8. These sheets are prepared daily and are in the hands of the various foremen by 8 a. m. They show each foreman just what work he should complete that day for each engine in the shop. In case something has arisen to prevent his completing certain work on the day previous, that work is again placed on his list and an X placed in front of it, indicating that it is a day late. An additional X is placed before the operation on each succeeding day that it remains uncompleted. It will readily be seen that this serves as a constant reminder to the foreman that he is behind in his work, and that steps will have to be taken to catch up with the schedule if the engine is not to be delayed.

A large sheet, combining the schedules for all engines, is kept in the schedule office and used with a straight edge by the schedule clerks for their guidance.

A list of all material that is late is also prepared daily for the benefit of the superintendent of shops and the erecting shop foreman. Orders for any further material, as mentioned in a preceding paragraph, or material which is necessary because of improvements in design, are passed through the schedule office and a record made on a special card form for reference by the schedule men when making out detail schedules.

CANADIAN PACIFIC RAILWAY COMPANY

ANGUS SHOPS SCHEDULE OFFICE 3/6/14

EAST MACHINE SHOP

Eng. No.	Material	Operations
840	1 R.B. Cyl. casing	Deliver
	Frict. gear	Deliver
3476	Stack	X Turn. Deliver
	Exhaust pipe	Deliver
6125	Stm. pipes (L.H.)	XX Rec. fr. Fdry. X Shape Del.
	Pistons	X Deliver
2513	Exhaust pipe	Turn.
	Smoke Box Front	Assemble
2113	Steam pipes	Shape
	Fric. gear	Rec. fr. Foundry
	Pistons	Deliver
	Cyl. covers	Deliver
778	Smoke box front	Rec. fr.Flange Shop
	Superheater headers	Plane
	Sand box	X Turn. Drill
	Pistons	Turn.
531	Buffer castg.	Deliver
	Center Castg.	Turn.
	Crossheads	X Key up Deliver
	Pistons	Grind rods
898	Front cyl. heads	Turn.
	Crossheads	Deliver
997	Deck castg.	X Deliver
	Buffer castg.	Shape
	Crossheads	XX Babbitt X Plane Key up
	Pistons	X Mill rods Turn rods
999	Frame	Deliver
	Tail bars	X Deliver
	Sand box	Rec.fr.Foundry
	Crossheads	X Assemble Plane
6214	Expansion brackets	Plane
	Pistons	X Rec.fr.Fdry.(heads) Bore
2750	Cyl. (L.H.)	Rec.fr.Erecting Shop
	Cyl. bushing	Drill
	Valve bushings	Mill
	Crossheads	Assemble
3040	Frames	XX Rec.fr.Smith Shop X Plane Slot
	Frame fillers	X Plane Rec.fr.E.S.
	Deck castg.	Plane
6051	Top rails	X Rec.fr.Smith Shop
2226	B. Cyl. head (L.H.)	Rec. from Foundry
1014	Cyl. (R.H.)	Bore
3382	Rep. mat.	Rec.fr.Erecting Shop
New Engine Material		
2661	Frame fillers	Deliver
	B. Cyl. covers	Deliver
	B. Val. covers	Deliver
	Center castg.	X Deliver
2662	Steam pipes	Deliver
	Stack & Hood	Deliver
2663	Cyl. & Valve casings	Deliver
	Friction castg.	

Fig. 8—Operation Sheet

As the various operations necessary to completion fall due they are daily added to the foreman's operation sheet. It will be seen by examining the operation sheet in Fig. 8 that foremen and charge hands are not only given advance notice of the work which they will have to commence on any particular day, but are reminded every day of the work that has been permitted to fall behind. The chance of any one item being lost sight of is thus reduced to a minimum.

The schedule men follow the progress of the work on the

various parts through the shop, keeping in touch with the operations and checking them off the operation sheets as they are completed.

The schedule office also acts in a large measure as a clearing house. If a foreman needs material from another foreman he takes the matter up through the schedule office. As the order was placed by the office, the records there tell exactly on whom and when the order was placed. With this schedule system a definite order is established for each operation and everything is done systematically. It is impossible for a foreman to overlook any piece of work, as he has a daily reminder in his operation sheet.

In order to show the methods used in making out the operation sheets, an erecting schedule is shown in Fig. 9, and a boiler schedule for the same engine in Fig. 10. These are for No. 1 repairs with heavy boiler work, and show how the boiler work is dovetailed in with the machinery repairs. The time in this case was extended to 25 days, owing to the boiler work necessary.

In explanation of the apparently long period of time taken for the boiler work, it should be stated that it is the practice on the Canadian Pacific to make up the new sheets as they are required; a large stock of boiler sheets is not carried as is the practice on some roads.

In making out the daily operation sheets for the use of the erecting shop foreman and charge hands, the erecting shop schedule clerk has a master operation sheet like that shown in Fig. 9 for each engine in the shop. For example the operation appearing on the sheet for engine 3510 for March 20 will be "shoes and wedges to be laid off." Similarly, various operations will appear for every other engine in the shop, and operations previously shown as due and not yet completed are also shown preceded by an X for every day they are overdue.

The boiler work and the work of other departments are handled in a similar manner.

C. P. RY. ANGUS SHOPS

ERECTING SHOP

LOCOMOTIVE REPAIR SCHEDULE

Date	Day	Operations	Date	Day	Remarks
2/28	1	Off wheels. Strip for Test. Test boiler.			
		Smoke box door and netting off.			
3/2	2	Stripping completed. Steam and exhaust pipes out.			
3/3	3	Material delivered. Headers out.			
3/4	4	(a) Boiler to boiler shop.- (b) Boiler ready for boiler makers.			
	5				
	6				
3/17	15	Frames brought in shop.			
3/18	16	Frames laid, cylinders set.			
3/19	17	Binders up, cylinders bolted, widths furnished.			
3/20	18	Shoes and wedges laid off, Motion plate up.			
3/21	19	Guides and crossheads lined up, boiler set and tested.			
3/23	20	Motion hung, spring gear up, engine wheeled.			
3/24	21	Headers in. Boiler lagged. Runboard brackets up.			
3/25	22	Motion finished, headers tested, runboards on.			
3/26	23	Valves set, brake gear up, cab on.			
		Steam and exhaust pipes in.			
3/27	24	Plates and netting in, rods on, trucks in place.			
3/28	25	Light work finished.			
3/30	26	Engine on trial.			

Note.- (a) If boiler is to have heavy repairs in Boiler Shop.
(b) " " " " " " " " Erecting Shop.

Eng. No. 3510

Rep. No. 1. Days 26

Stripping 3 Days
Boiler Work 16 Days
Erecting After Test 7 Days
Scheduled in 2/28. Out 3/30.
Gang Boss Bell.

Engine Repairs.

Conversion.

Boiler Repairs.

Sides, Tube and Back Sheet.

Shopping Record.

Engine in Yard 2/26/14.
Engine in Shop 2/28/14.
Engine on Trial 3/30/14.
Engine Delivered 3/31/14.
Days in Yard 3.
Days in Shop 26.
Days at Angus 29.

Delays.

Fig. 9—Erecting Shop Schedule for a Locomotive Undergoing No. 1 Repairs

Job: Sides Tube and Back Sheet

No. of days: 3 Days Stripping
16 Days Boiler Work

C. P. RY. ANGUS SHOPS.

BOILER SCHEDULE.

Eng. No. 3510

Class M. 4. g.

Date	Day No.	Schedule	Remarks
2/28	1	Engine in shop	
3/2	2		
3/3	3		
3/4	4	Boiler off, start drilling staybolts	
3/5	5	Finish drilling staybolts	
3/6	6	Cut out seams and mudring rivets	
3/7	7	Sheets out	
3/9	8	New sheets ready	
3/10	9	Hang sides. Back sheets ready	
3/11	10	Hang tube and back sheets. Close corners	
3/12	11	Rivet mudring	
3/13	12	Cork mudring	
3/14	13	Rivet tube and back sheets	
3/16	14	Rivet top seams	
3/17	15	Staybolts in and cut	
3/18	16	Rivet staybolts	
3/19	17	Rivet staybolts	
3/20	18	Tubes in	
3/21	19	Test	

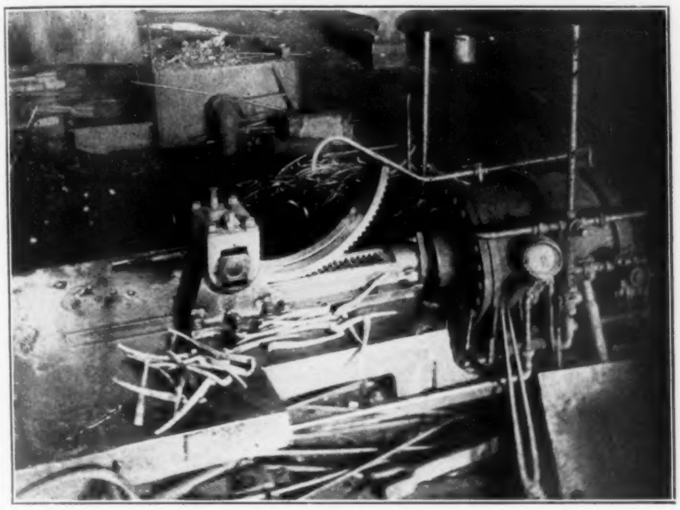
Fig. 10—Schedule for the Boiler Work in Connection with Fig. 9

Lighting Cars in Java.—In Java railway trains are not operated at night—that is from 7 p. m. to 5 a. m. Therefore very little provision is made for lighting passenger coaches. An acetylene plant has recently been installed, however, at Bandeong, and acetylene lighting apparatus is being substituted for oil lamps in the cars of the through trains.—*The Engineer.*

A CHEAP METHOD OF MAKING BRAKE SHOE KEYS

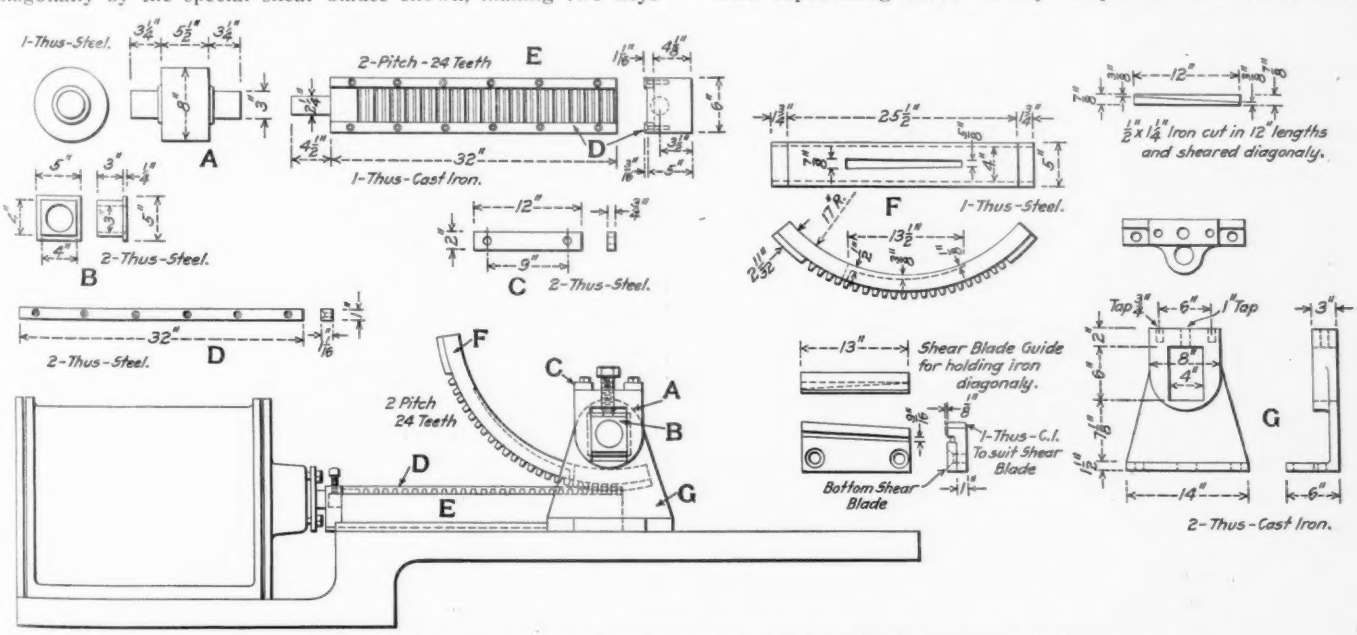
BY E. A. MURRAY
Master Mechanic, Chesapeake and Ohio, Clifton Forge, Va.

A new method of manufacturing brake shoe keys is in use at the Chesapeake & Ohio shops at Clifton Forge, Va. By employing the machine shown in the illustrations it has been found possible to reduce the cost of making these keys from 1.75 to 0.4 cents each. The output of one blacksmith formerly was 400 keys per day. The use of the device illustrated has accomplished an increase in the shop output to 4,000 per day, and with the use of much cheaper labor.



Machine for Making Brake Shoe Keys

It will be seen by referring to the engravings that the keys are made from ½ in. by 1¼ in. flat iron. The first operation is to cut the stock to 12 in. lengths, after which it is sheared diagonally by the special shear blades shown, making two keys out of one length. The second operation consists of heating the iron and rolling it to shape. The tool used in the operation is designed so as to turn the gib on the end of the key and roll it to the proper length and radius in one operation.



Details of Machine Used for Making Brake Shoe Keys on the Chesapeake & Ohio

This work is accomplished on an ordinary bending machine, common to almost any railway smith shop, consisting of an offset slab to which is fastened an air cylinder. The piston of this cylinder is connected to a gear rack, which in turn engages the gear segment, the back of which acts as a former for the key.

This device is the invention of R. L. Woodrum, smith foreman at Clifton Forge, Va.

EFFICIENCY

BY ROBERT W. ROGERS
Instructor of Apprentices, Erie Railroad, Port Jervis, N. Y.

There has been so much talk on safety first and safety always, that it seems well to call to mind that if anything is done efficiently it will be done safely. There are several considerations that railway employees should bear in mind in carrying out the idea of efficiency.

Beginning at the bottom of the ladder, the laborer can often save much time in accomplishing his work. He frequently walks a greater distance than is necessary; and how often three men are called upon to lift a weight when two would be sufficient. The tools supplied the laborer are often inadequate, or they are not the proper kind; a shovel that is too long or too short is difficult to use and wastes time. A gang leader can get improved results very often by studying how best to use the men and tools furnished him.

Machinists, boilermakers, blacksmiths, and all other shop men should learn to use their tools to produce the best results in the shortest time. A good man in any of these lines of work must have initiative; in these days of piece work, it is becoming more and more necessary for the rapid turning out of good work, if the man is to make a good income.

The more efficient a man is the more money he makes. In doing any job, it is the worker's first duty to see that his machine or tool is in proper condition, that no one is likely to be struck by the moving parts of the machine or by flying chips, and he should plan his work so that he may know just how the various steps follow each other.

The supervising force in any shop should first see that the workmen are protected from injury, and then intelligently direct them in their work. They should always be ready to supply advice, when needed, as to how best to perform a job. Such co-operation between the supervising force and the workmen is bound to give more correct and rapid results in turning out work.

LOCOMOTIVE AND CAR REPAIR NOTES

BY W. T. GALE

REPAIRING INJECTORS

When removing injectors, the repair man will often use a hammer and set in loosening the nuts instead of using the proper wrench. This practice will knock the injector connections so much out of shape that in time it will be impossible to make a tight joint. The tools and jigs shown in Figs. 1, 2 and 3 are used to contract or expand these holes and bring them back to the proper size, which in many cases will save scrapping an old injector. Fig. 1 shows how the contracting tool is applied to reduce the size of the connection so that the bonnet will have a snug fit, and Fig. 2 shows the construction of the jig. The body *A* contains three slots for the adjustable block *B*. Each block has a small steel roller which rolls the injector connection back into shape. The blocks are held in place by a pin *D* on each side of the slots, and they are forced in by a set screw. The handle *F* is applied to the body at *H* and is long enough to give sufficient leverage to turn the jig after the set screws have been set up. One of the connections which is to be closed up is shown at *E*, and *C* is the plug which is screwed in the connection while it is being rolled. The expander is shown in Fig. 3, and consists of a sectional steel bushing and a tapered plug. The inside of the bushing is bored to correspond to the taper of the plug and the outside contains a groove for a steel snap ring to hold the four sections in line. The bushing is made to fit the smallest hole to be expanded, the taper in the plug taking care of the larger holes. The plug is driven in by a hammer and the bushing is turned frequently to prevent ridges forming on the inside of the hole.

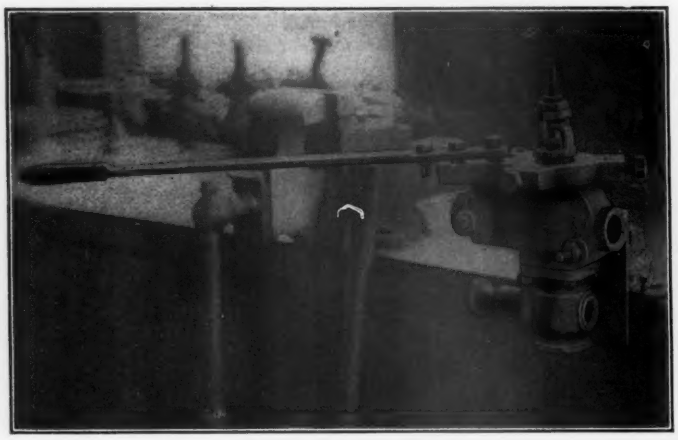


Fig. 1—Application of Jig for Reducing Injector Connections

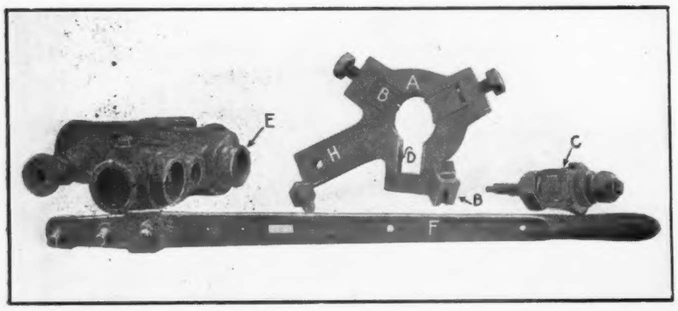


Fig. 2—Jig for Reducing Injector Connections

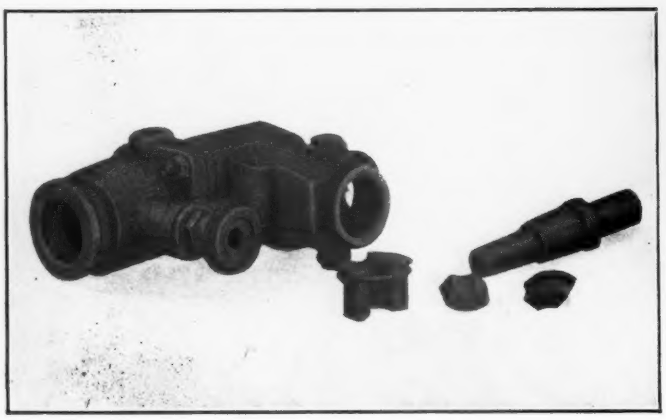


Fig. 3—Jig for Expanding Injector Connections

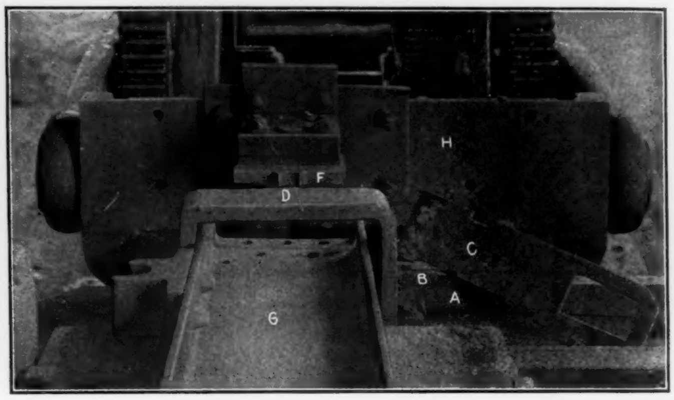


Fig. 4—Bulldozer Equipped for Shearing Rivets from Truck Transoms

RECLAIMING CAR TRUCK TRANSOMS

An inexpensive method of shearing rivets from freight car truck transoms is shown in Figs. 4, 5 and 6. A No. 4 Williams & White bulldozer is equipped with the shear *F* as shown in Fig. 4. This shear is bolted to two heavy angle bars, which are riveted to a plate and the plate is bolted to the face of the bulldozer. The transom is held as shown in Fig. 5. It is raised to the proper height by the wedge *A* and the bar *B*, the gage *C* being used to measure the height above the table. A bracket *D* is placed over the channel to prevent it from moving out of position. The thrust of the shear is taken up by the back stop *E*, which is rigidly clamped to a heavy block foundation. The rivets in the flanges are removed by a small shearing tool under a steam hammer, as shown in Fig. 6. This method saves considerable time in removing the 22 rivets in each one of these channels, as with the old hand process only 18 channels could be finished in a ten hour day, whereas with this

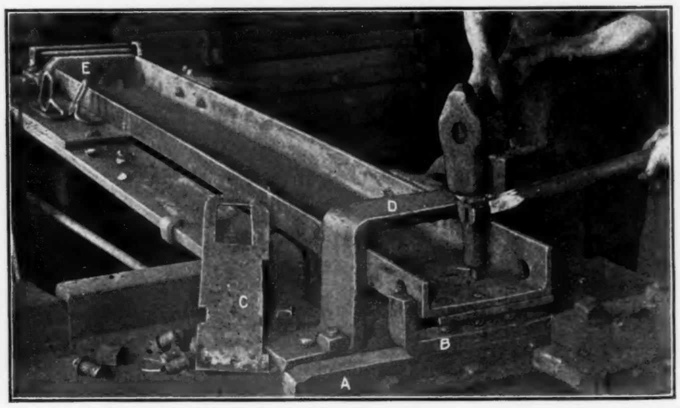


Fig. 5—Holding the Transom While the Rivets Are Being Sheared on a Bulldozer

method 145 channels can be reclaimed in the same time. With the channels shown in the accompanying illustrations seven rivets are sheared at each stroke of the bulldozer. Fig. 5 shows the method of driving out the sheared rivets. After all

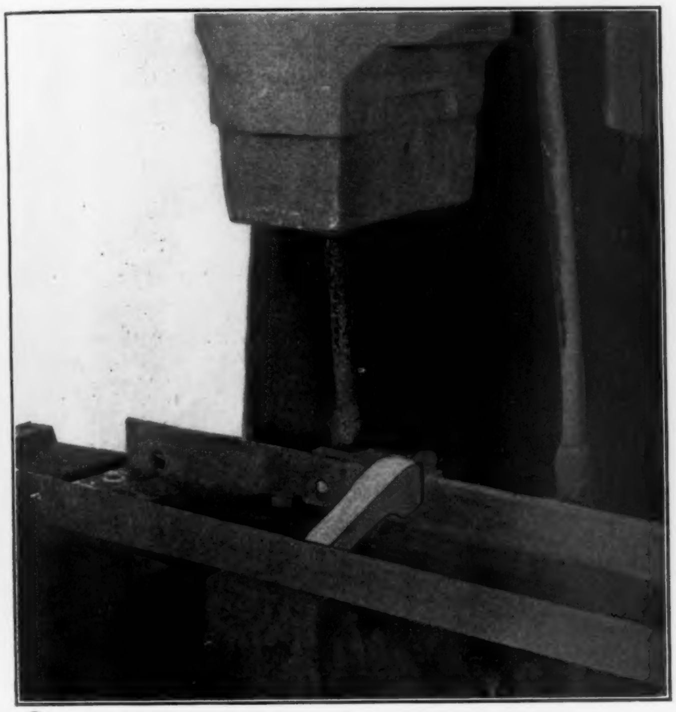


Fig. 6—Shearing Rivets from the Flanges of Truck Transoms

the rivets are removed the channels are straightened and used again.

REPAIRING VALVE SPINDLES

A tool and jig used for facing back the threads on valve

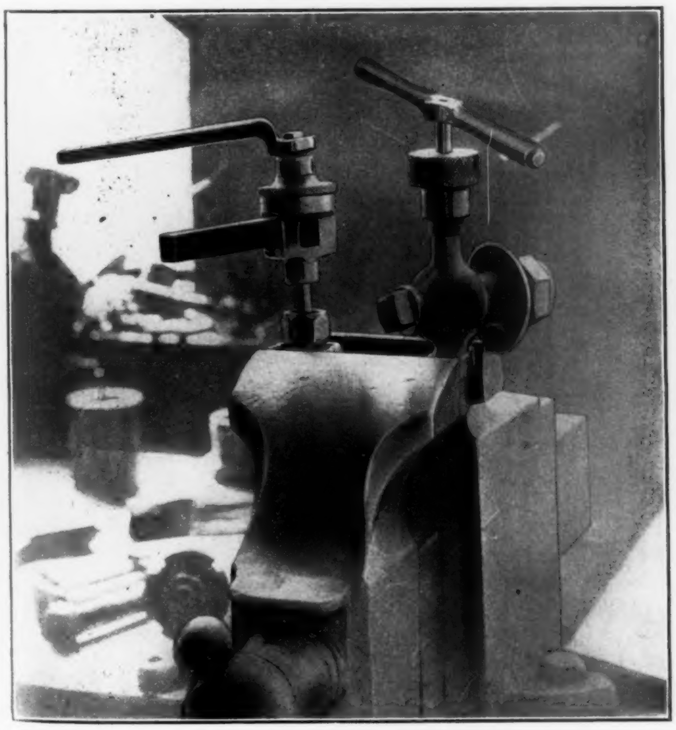


Fig. 7—Jigs for Repairing Valves

spindles is shown in Figs. 7 and 8. The spindle is held in a vise and the jig *A*, Fig. 8, which holds the tool, is screwed down over the stem. The tool *B* has a hole through it which fits over the small end of the valve spindle, and the bottom is made similar to an end reamer. The tool is held central in the jig by the cover plate *C*, which screws into the jig and bears on a shoulder on the tool. The tool is turned by the wrench

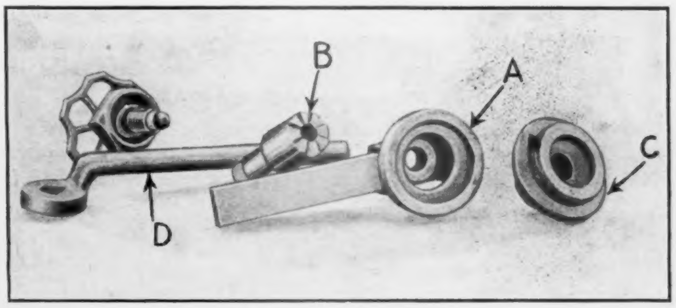


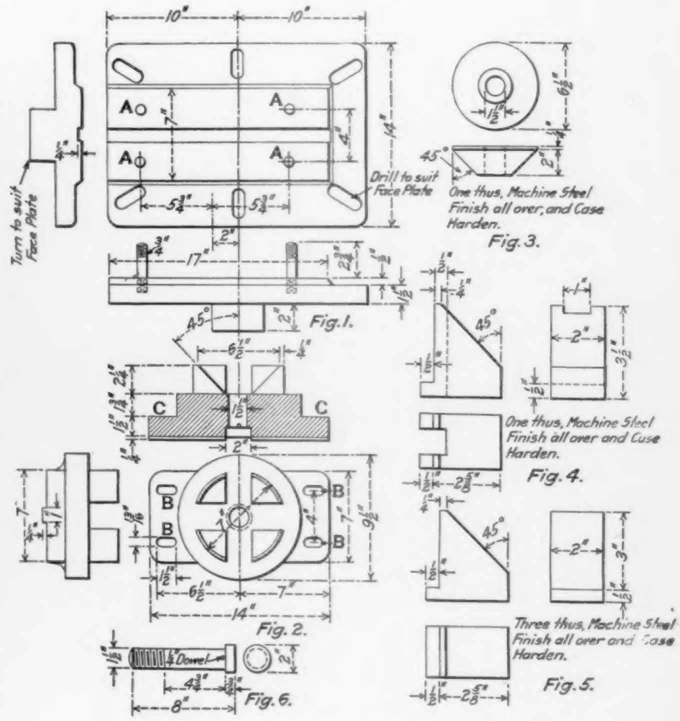
Fig. 8—Details of Jig for Repairing Valve Spindles

D and is driven down by screwing the cover plate further into the jig *A*. This device will be found valuable in the engine house for such work and modifications of it have been used to finish off the valve seats of water glass and gage cocks.

CHUCK FOR TURNING ECCENTRICS

BY PAUL R. DUFFEY

The chuck shown in the engraving is used to hold locomotive eccentrics in proper alinement with respect to throw, for turning the outside face. Fig. 1 shows the base plate, which may be altered in design to suit the machine on which the work is done. The four studs *A* are used to hold the main chuck plate, Fig. 2. This plate is drilled at *B* so that it may be shifted a reasonable distance on the studs *A*. The eccentric rests on the face *C*,



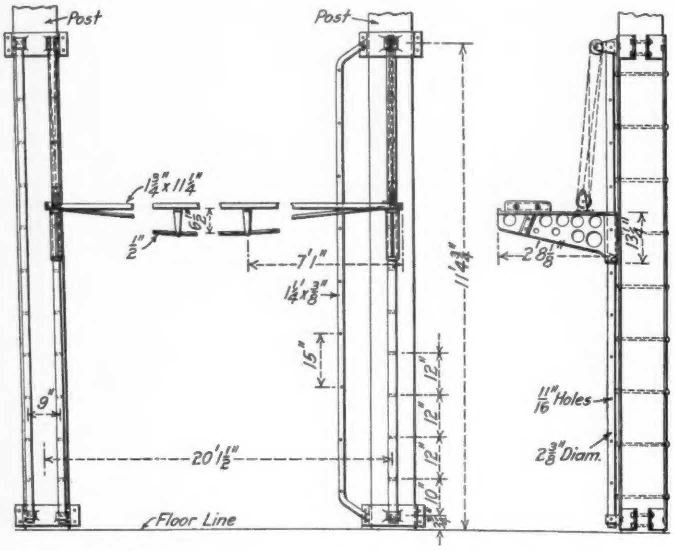
Details of Chuck for Turning Eccentrics.

Fig. 2, and is held rigid by means of the dies, Figs. 4 and 5. These are pressed against the sides of the eccentric by means of the expanding plate, Fig. 3, being pulled down to place by the pin shown in Fig. 6. The die, Fig. 4, is slotted to engage with the keyway in the block, which helps to insure proper alinement as well as providing an extra means of clamping.

ADJUSTABLE PLATFORM FOR CAR SHOPS

BY GEORGE E. McCOY

The adjustable platform shown in the line engraving is in use in the passenger car paint and repair shops of the Canadian Government Railways at Moncton, N. B. The construction is shown clearly in the illustration. The plank which forms the platform has two truss rods and king posts strengthening it below. This plank is supported at either end by a bracket which is so arranged that it can be raised and lowered by means of



Adjustable Platform Used on the Intercolonial

pulleys and a hoist. The brackets are guided by 2 in. pipes supported against the shop posts. These pipes are drilled every 12 in. with 11/16 in. holes, and the brackets rest on pins which are inserted in these holes. A ladder is provided at one end of the platform as shown.

SOME MODERN METHODS OF WELDING

Thomas Heaton, member of the Institution of Mechanical Engineers, presented an interesting paper before that society February 20, 1914, on electric and gas welding systems. Mr. Heaton described briefly the different systems in general use today. He believes that this new type of welding is much better for certain classes of work and produces far better results than the old method of welding in the coke fire. As regards the gas used for gas welding, it was believed that acetylene gave the best results, and of the electric processes, that the electric arc was more suitable. It was also stated that both the gas and the electric systems have fields of their own, and were economical when used in their own spheres. In general, however, he also believed that the electric is far more effective because the heat is produced within the work itself, whereas the heat of the gas flame is applied entirely from the outside. Where work is suitable for the electric arc, welds can be made far more quickly than by the oxy-acetylene flame. Concerning the strength of the weld he spoke as follows:

"The character of the metal at the weld is changed to some extent when welded by these processes. It loses some of its ductility and some of its strength, but loses far less than does a blacksmith's weld. Many tests have shown that 89 to 96 per cent of the original strength of the metal can be relied on in the electric welds. It has been said that the electric welding hardens the metal by filling it with carbon from the electrode. This is not the case. For example, in welding mild steel the fierce heat of the electric arc burns out all the impurities more or less, including the carbon, and leaves the metal at the weld pure iron. If any hardening defect has ever been found it has been due to bad manipulation, or to the fact that the metal was never of a proper weldable quality, or the polarity was wrong."

The accompanying tables show the effect of the welding upon the metal. The plates were tested mechanically, both longitudinally and transversely along the welded joint, and for comparison, the unwelded metal is used. The results of the mechanical test of the unwelded metal are the mean of three lots. The chemical analyses and the mechanical tests were made in August, 1913, by F. C. Tipler, chief chemist, locomotive department, London & North Western Railway, Crewe. The pieces of material were prepared at the works of the Steel Barrel Company, at Uxbridge, and were of Siemens-Martin open hearth steel ⅛ in. thick.

Table 1—Chemical Analyses

	Electrically welded		Acetylene welded	
	Unwelded metal Per cent.	Welded joint Per cent.	Unwelded metal Per cent.	Welded joint Per cent.
Silicon	0.009	0.003	0.009	0.002
Carbon	0.15	Trace	0.15	Trace
Sulphur	0.025	0.020	0.085	0.071
Phosphorus	0.068	0.043	0.068	0.067
Manganese	0.64	0.27	0.49	0.34
Iron (by difference)	99.108	99.664	99.198	99.520
	100.000	100.000	100.000	100.000

Table 2—Mechanical Tests on Mild Steel ⅛ Inch Thick

	Electrically Welded			Acetylene Welded		
		Welded joint			Welded joint	
	Un-welded	Trans-verse	Longi-tudinal	Un-welded	Trans-verse	Longi-tudinal
Elastic Limit Tons per sq. in.	15.20	17.60	Nil	11.76	11.60	Nil
Breaking Weight Tons per sq. in.	26.66	24.00= 90%	25.60= 96%	23.14	18.24= 78.8%	23.20= 100.2%
Contraction of area Per cent.	47.25	Nil	Nil	46.66	49.60	Nil
Extension on 4 inches Per cent.	23.16	5.00	0.50	26.33	13.50	4.25
Extension on 2 inches Per cent.	30.33	7.00*	1.00†	33.66	22.00‡	8.00

*Broke in weld. †Broke outside gage length. ‡Broke clear of weld.

Table 3—Mechanical Tests on Two Strips of Siemens-Martin Mild-Steel Sheet ⅛ Inch Thick.

	Breadth of testpiece	Thickness	Area	Maximum load		Extension on 4 in. length	Reduction of area	Remarks
				On piece	Per sq. in.			
	Inch	Inch	Square inch	Tons	Tons	Per cent.	Per cent.	
1	1.480	⅛	0.185	4.06	21.95	32.03	29.63	Original
2	1.478	⅛	0.185	3.59	19.41= 88.428%	10.93	5.23	Electrically welded

Increasing Size of Steam Turbines.—There is an extraordinary development taking place in the size of the individual unit in the field of steam turbines. We were commenting a short while ago on the fact that a unit of 20,000 kilowatts had been built; yet during the past year one of this size and another of 25,000 kilowatts have been built, and it is stated that orders have been placed for four of 30,000 kilowatts and one of 35,000 kilowatts.—*Scientific American.*

Weight of Locomotive "Puffing Billy."—The Board of Education, South Kensington Museum, London, has furnished the following particulars regarding the celebrated locomotive "Puffing Billy," whose centenary occurred last year. The weight of the engine in working order was 8 tons 6 hundredweight, and of the tender 4 tons 6 hundredweight, making a total weight of engine and tender in working order of 12 tons 12 hundredweight. At a speed of five miles an hour, "Puffing Billy" was able to haul about 50 tons, but on occasions as much as 70 tons was hauled at a reduced speed.—*Scientific American.*

Grinding Wheels and Their Use

Discussion of the Character of Wheel to Be Used and the Speed at Which It Should Be Run

BY A. R. DAVIS
Tool Foreman, Central of Georgia, Macon, Ga.

In selecting proper grinding wheels for the various classes of work in the locomotive repair shop the following features must be considered: The rapidity of grinding or cutting desired; the total amount of work to be performed; the finish to be produced.

These three elements are usually of importance in the order given. The speed of a wheel and other operating conditions being the same, they are influenced as follows:

The rapidity of cutting is increased by using a coarser grit or softer grade of wheel.

The total amount of work performed by a wheel is increased by using a finer grit or harder grade.

The finish produced is improved by using a finer grit together with a softer grade.

Other considerations to be noted in selecting wheels are:

The kind of metal to be ground: Cast iron varies to such an extent that wheels should vary in like ratio to get the best results. Nos. 24 to 38 grit with combinations of grades varying with the hardness of the iron will prove satisfactory. Cast iron and hardened steel require wheels of similar grades.

Its forms (whether surface or edge work); The greater the area of contact the softer the grade of wheel that will be required. This is probably due to the fact that as the contact area is increased, the load increases in the same ratio and dulls the grits faster, making it necessary that the bond be more friable, so that the dull grits may escape easier and require less pressure to allow the wheel to cut rapidly.

Grading of Grinding Wheels

Manufacturer.	Material			Extra soft	Very soft	Soft	Medium soft	Medium	Medium hard	Hard	Very hard	Extra hard	Special hard
Norton Co.	Alundum	Crystolon		...	...	E	I	M	Q	V	...	Y	...
The Carborundum Co.	Carborundum	Aloxite		Z	W	T	P	M	I	G	D	...	...
Safety Emery Wheel Co.	Emery	Carbondite	Vitrified	C	H	A	M	P	I	O	N	E	D
			Silicate	6	5	4½	4	3½	3	2½	1½	1	...
American Emery Wheel Works	Emery	Carbolite	Vitrified	...	G	I	...	M	P	...	S	V	...
			Silicate	...	½	1½	...	3	4½	...	7	...	...
Abrasive Material Co.				...	H	K	...	M	O	...	T	...	Z
Sterling Emery Wheel Mfg. Co.	Emery	Carrundum		...	...	1	...	2	3	4	...	...	...
Vitrified Wheel Co.				...	...	C	D	E	...	F	...	G	...

The speed at which the wheel runs and whether wet or dry: A wheel too hard or running too fast heats and glazes; if too soft, it cuts and wears away quickly. Silicate wheels are best adapted for tool and knife grinding.

Wheels should be harder for hand operation than machine fed; heavy feed or pressure causes excessive wear of wheels; high speed will cause excessive wheel wear.

In connection with selecting grinding wheels, the foreman is confronted with the arbitrary methods of grading used by the manufacturers. Many companies use the same grading for vitrified and silicate wheels, while some use separate grading for the latter. Most use a separate system for elastic wheels grading by numbers, 1 to 11, and using fractional numbers.

The accompanying chart shows the variation of the grades. This is very confusing to the shop man as few can keep in mind the different gradings in comparing wheels of different makes, and it has undoubtedly been the cause of many failures in securing proper duplication of wheels. It also makes it difficult to recommend a grade of wheel without including the maker.

Railway shop grinding may be classed as cylindrical, surfacing, hand and tool.

Of the cylindrical grinding, we have piston rods, valve stems, pump rods, etc., ground on a plain cylinder grinder, and bushings and pins for motion work. On piston rods and valve yoke stems to get a good finish at an economical rate requires the adjustment of many conditions as follows:

The work should be turned with a coarse feed, ⅛ in. or over, leaving 1/64 in. to 1/32 in. stock to grind. This will reduce the cost of turning and the coarse feed helps to keep the wheel from glazing. The centers should be in good condition.

Rests should be placed at not less than 15 in. intervals and should have a positive feed. Spring rests will not prevent chatter on work that is out of round if heavy cuts are taken.

The work (.003 carbon steel and special alloy steel heat treated) should have a speed of from 30 to 70 ft. per minute, according to its diameter, the larger diameters having a much greater area of contact with the wheel and consequently a heavier load, should revolve at a slower rate to avoid chatter. The same wheel may be used on different classes of material by varying the speed of the work.

Using from ½ in. to 1 in. traverse per revolution will meet the average requirements and give a good output. To use coarse traverse requires slow working speeds and a grinding wheel of a suitable combination of grits, 24 and 46, and of a medium grading.

The depth of the cut bears an inverse ratio to the traverse and can be increased as the traverse is decreased. As a general rule there is less wear on the wheel with a greater traverse and less depth of cut. An average of ¼ cubic inch of stock per minute can be removed without chatter.

Chatter marks, flats parallel with the axis and spiral mottled marking at irregular intervals, are caused by the vibration of the wheel and work acting together during the grinding, the wheel cutting the work as it vibrates. Some wheels will chatter and some will not on the same class of work. The mottled or spiral chatter is nearly always caused by the vibration of the machine, a wheel out of balance or a spindle loose in the bearing.

Plenty of water and the proper location of the nozzle are necessary for good work. The nozzle should be placed to have the water strike the wheel just above the point of contact with the work and not in a wide thin stream, since the air currents from the sides of the wheel will spray the water on both the machine and the operator.

This class of wheel should be trued with a carbon stick or other points affording a rigid tool to face the wheel. A hand held dresser will not leave the wheel in condition to produce fast work with a good finish. A loaded wheel is one that has particles of metal adhering to its face and filling in the crevices of the wheel, causing heating. A glazed wheel has its cutting particles dull and worn down even with the bond. Using a dresser

is not truing, but sharpening a wheel, and should not be done on a wheel used to grind work on centers. In truing wheels, the carbon or diamond points should be held rigid, as a wheel must be a true cylinder to produce a true cylinder.

In grinding case hardened valve motion work, bushings, pins, etc., on a dry cylindrical grinder, wheels of 46 or 50 grit and of a medium to a medium soft grade give good results for external work, the amount of stock to be removed being small. For the internal grinding of bushings a 50 to 60 grit and a medium to a medium hard grade will give a quick and a good finish.

Of locomotive parts, for the surface grinder there are guide bars, slide valve faces, valve strips, links, drop forged valve stem and piston rod keys, rod keys and liners, etc. In grinding machinery steel guides on a face grinder with a 30 in. cup wheel, dry, a table travel of 10 ft. per minute gives a good finish and a quick job, doubling the output of the wet wheels previously used.

For this a wheel of a combination of grains and grades, 141-N-SNTS (Carborundum grading) cuts fast and cool and produces a chip resembling the ordinary chip from a face mill. The wheel should be kept true and the work clean. The feed will be governed by the width of the face ground, but should be uniform. A wheel of this class will remove stock at the average rate of 1 cubic inch per minute.

Slide valves, valve strips, links and plates for motion work, drop forged valve stems and piston rod keys, pump packing rings, liners, etc., are ground on a vertical surface grinder with a 12 in. cup wheel using a magnetic chuck for holding the work With a table speed of 6 to 10 ft. per minute and feed in proportion to the width of the face to be ground, grinding has proved the most economical method of machining as well as producing the best finish for a wearing face. For grinding cast iron, silicate wheels of a combination of grits 30 and 38 and of a medium soft grade give clean rapid work; .4 cubic inches per minute should be removed. Slide valves will average 3 cubic inches of stock removed.

For case hardened steel and drop forgings a silicate wheel of a combination of grits 24 and 38 and of a medium soft grade gives good results.

For tool steel, carbon and high speed, a wheel of 30 grit, medium grade, will cut rapidly and remain cool.

We have found it more economical to grind shear blades, inserted blades for large milling cutters and reamers, bolt cutter dies, car wheel boring tools and all tools of this class, from the rough, instead of milling or planing, where the amount of stock is 1/16 in. or less. This class of machine can remove 30 cubic inches an hour and should have a heavy flow of water. The power required under full load will be about 10 h. p.

Wheels of 40 to 50 grit and of medium to a medium hard grade have given good results on links in the radius grinder. A traverse of 12 ft. per minute with a feed of one-half the wheel face and a cut of .002 in. depth will produce rapid work with a good finish.

In placing wheels of large size in the various departments for general use, the smith and boiler departments require the harder grade of wheel, as the bulk of the grinding is on the edges. A 16 to 20 grit and a medium hard to a hard grade will meet these requirements. For the general work in the erecting and machine shop departments on work that replaces the chisel and file, a wheel of 24 grit and a medium to a medium hard grade will cut free on most of the material used except brass. This can be handled to better advantage on a disk grinder with a 16 grit. This applies to rod brass work especially, the disk grinder being an economical method of facing halves of split bushings.

For lathe and planer tools a wheel of 24 grit and medium hard grade gives good service for hand grinding, while the same grit but of a slightly softer grade cuts cooler and faster in the machine fed tool grinders.

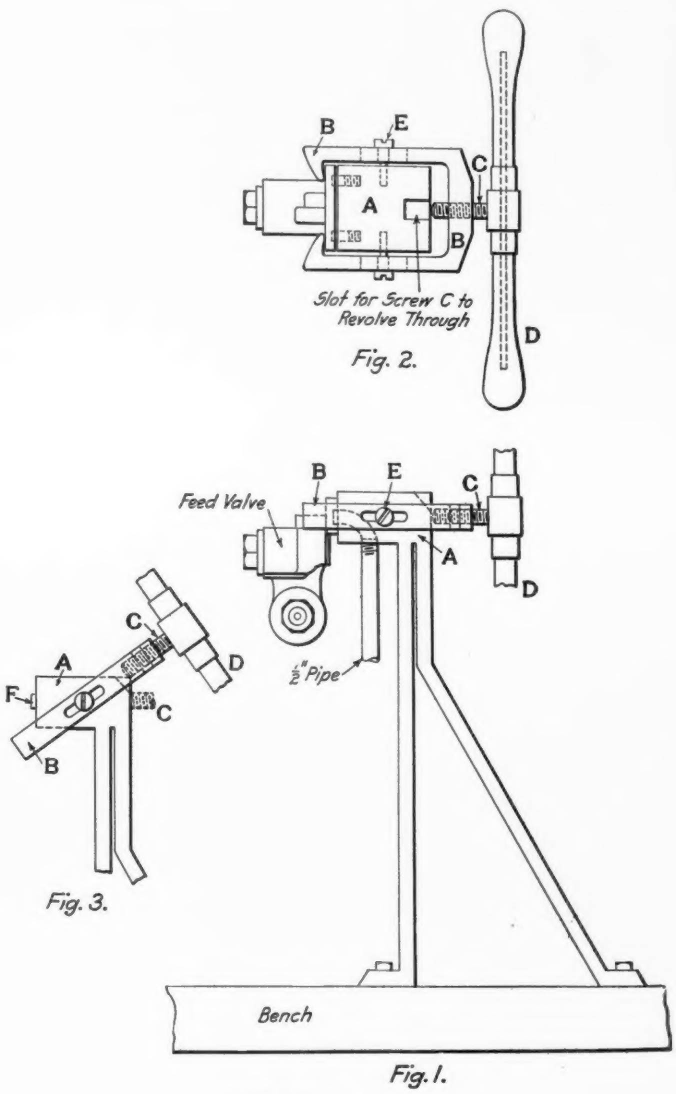
In connection with tool grinding, high speed steel should be ground dry or with a large stream of water. For grinding finished tools in special machines, wheels of from 46 to 60 grit and medium to medium soft grades for both cylindrical and surfacing, cut fast and cool. For form grinding, threading dies in the throat, etc., a wheel of 50 grit and just below a medium hard grade will hold its shape and cut fairly fast.

FEED VALVE TEST RACK

BY J. A. JESSON
Air Brake Foreman, Louisville & Nashville, Corbin, Ky.

The drawings show a quick action device for testing feed valves. Fig. 1 gives a side view of the device attached to a bench. It consists of a body *A*, a clamp yoke *B*, a 5/8-in. screw *C*, a handle *D* and cap screws *E*. Fig. 2 is a top view and Fig. 3 shows the clamp yoke *B* when in position for releasing the valve. The pins *F* are for guiding the valve to position on the face of the body *A*.

In operation, the yoke is raised as shown in Fig. 3, the valve is placed over the pins *F* and against a 1/16-in. gasket. The yoke is then placed in the position shown in Fig. 1 and the tightening of the screw *C* causes the yoke to pull the valve against the face of the body *A*. The sides of the yoke are slotted to allow for longitudinal movement. A slot is cut across the corner of the



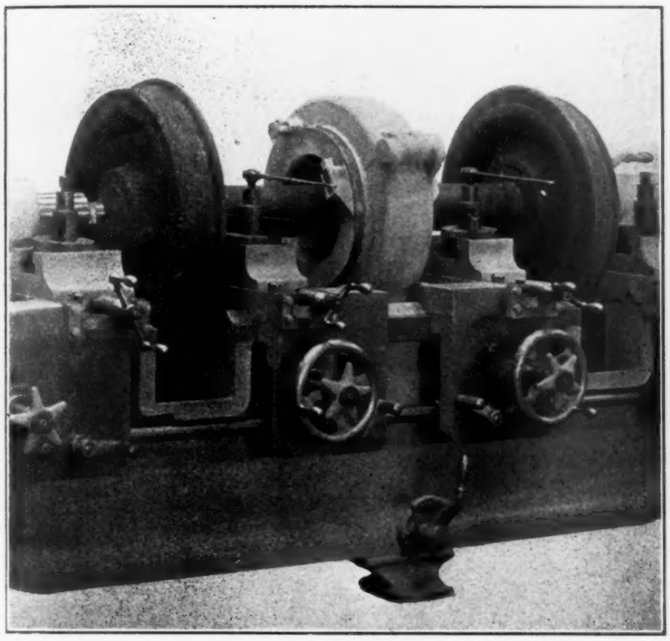
Feed Valve Test Rack

body, which permits the yoke to revolve as soon as it is released sufficiently to clear the valve. The 1/2-in. inlet and outlet pipes are tapped into the lower side of the body. The drilled ports are thoroughly tinned to prevent leakage. The device is made of machinery steel and is amply heavy to withstand shocks.

New Devices

BRIDGEFORD GAP AXLE LATHE

A center drive gap axle lathe with two carriages, designed specially for use in railroad shops where it is desired to turn the journals of car axles without removing the wheels, is shown in the accompanying illustrations. This machine has been de-



Lathe Equipped for Axles with Journals Between the Wheels

signed and is built by the Bridgeford Machine Tool Works, Rochester, N. Y., and in construction is very similar to the other axle lathes built by this company.

This machine is designed to be placed in a pit so that the axles with wheels attached can be placed in the centers very readily. The driving gear in the center is in two pieces of tongue and groove construction, bolted together by four heavy hinge bolts. These fastenings can be released with less than one-half turn of each nut and the upper half of the driving head operates on a heavy hinge stud placed in the front of the machine. To lift it, the pull pin is pushed in place and the nuts are released. An eye bolt is placed on the upper half of the head and to this can be attached a rope with counterweights operating a set of sheaves.

The driving head throughout is very powerful and of heavy construction. The gear has a 5-in. face and runs in heavy bronze bearings scraped to a fit. The lathe is furnished with a self-centering steel driver plate operated on the same principle as on the company's previous axle lathes. The power is applied to a constant speed pulley at one end of the machine and if motor driven, is belted direct to the motor mounted on the driving end as shown in the illustration. There are three variations in cutting speed provided, which are controlled by a speed variator through a heavy steel gearing running in oil. The changing of speed is accomplished by shifting levers and the power is transmitted from the speed variator to the driving head by a shaft placed within the frame.

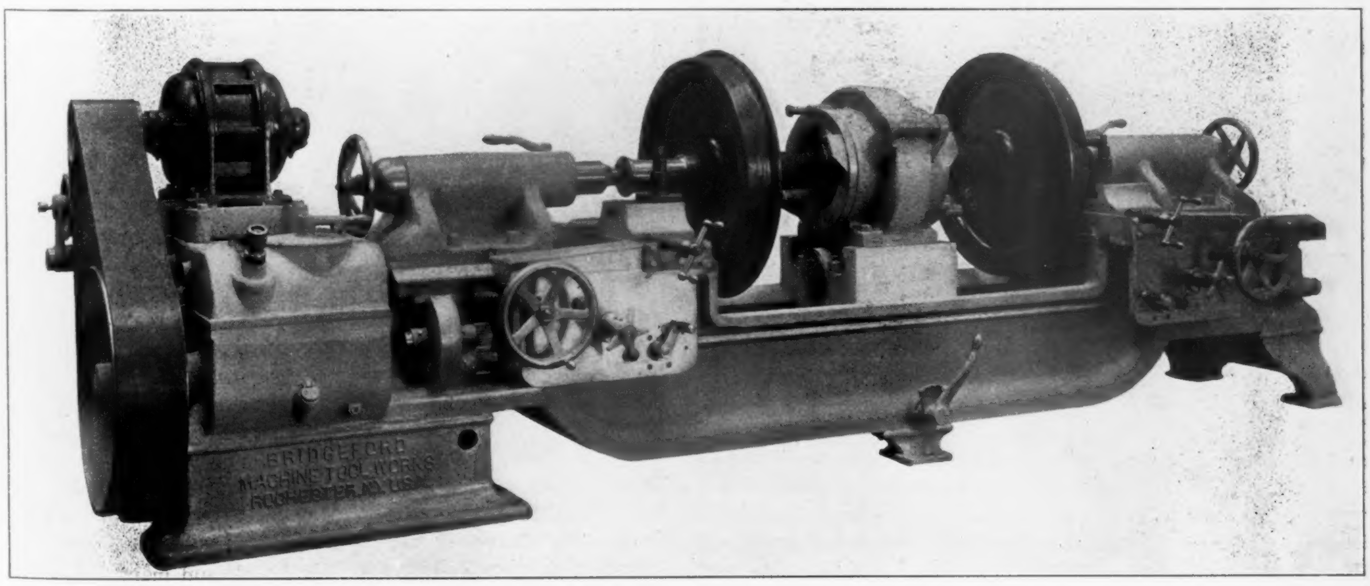
Four changes of feed ranging from 1/16 in. to 3/16 in. per turn of the axle are provided by a feed box. The lever shown in the center of the machine controls the feed.

The carriages are driven by a splined feed shaft through a rack and pinion. The direction of the feed is changed at the apron and the carriages are entirely independent of each other. They have a bearing on the Vs 30 in. in length and also bear on the back of the bed in a manner which will provide for taking up the forward thrust. In this way, any tendency to raise the carriages from the Vs when a burnisher is used is obviated.

If desired, this machine can be equipped with two extra inside carriages for refinishing locomotive and trailer axles with inside journals. This is shown in one of the illustrations.

Some of the general dimensions are as follows:

Distance between centers, minimum	54 in.
Distance between centers, maximum	105 in.
Swing over ways	27 in.
Swing over carriage	13½ in.
Swing in gap	45 in.
Driving pulley	30 in. diam. for 8 in. belt
Weight of lathe with two carriages	16,000 lb.
Weight of lathe with four carriages	18,000 lb.



Center Drive Axle Lathe, with Gap for Refinishing Journals of Mounted Axles

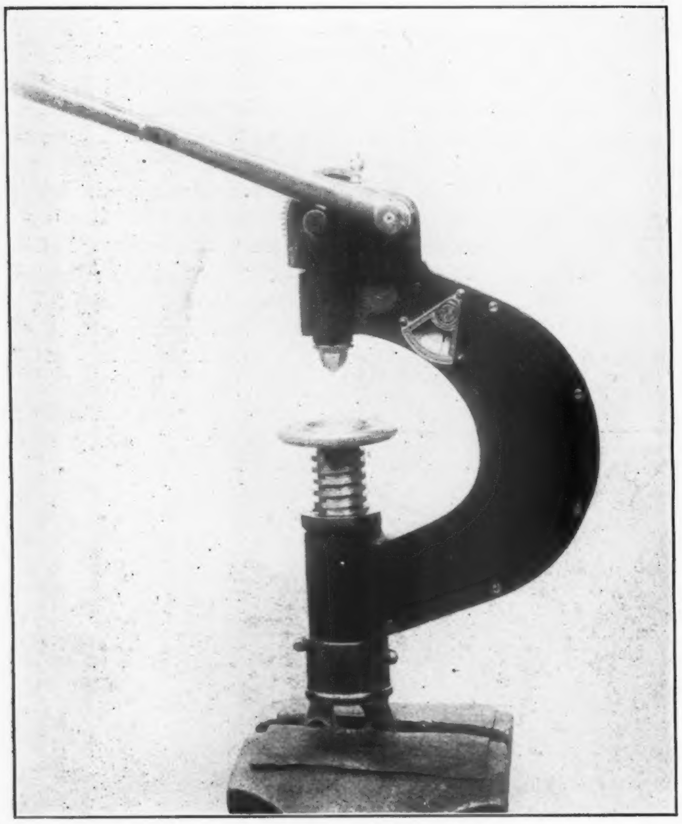
DERIHON PORTABLE HARDNESS TESTING MACHINE

A machine for testing the hardness of metals according to the Brinell method, which is that of making an impression with a 10 mm. ball under a pressure of 3,000 kilogrammes, is shown in the engravings.

One of these shows the machine ready for the test, with the lever raised and resting on the shaft. The piece to be tested is placed on the table of the machine, which is then raised until the piece is in contact with the ball. The lever is then pulled slowly over so as to give a progressive pressure until 3,000 kgs. are applied. When this figure is reached the lever is slowly returned to its former position and the test is completed. The pressure is registered by a small manometer. Under normal conditions it is usually sufficient to move the lever through an angle of 45 deg. to obtain the required pressure.

With each machine a small piece of steel is furnished in which a standard impression has been made, the diameter being stamped on it. This standard piece is made of an air hardening nickel-chrome steel. The accuracy of the machine can be easily checked by making an impression alongside the standard impression.

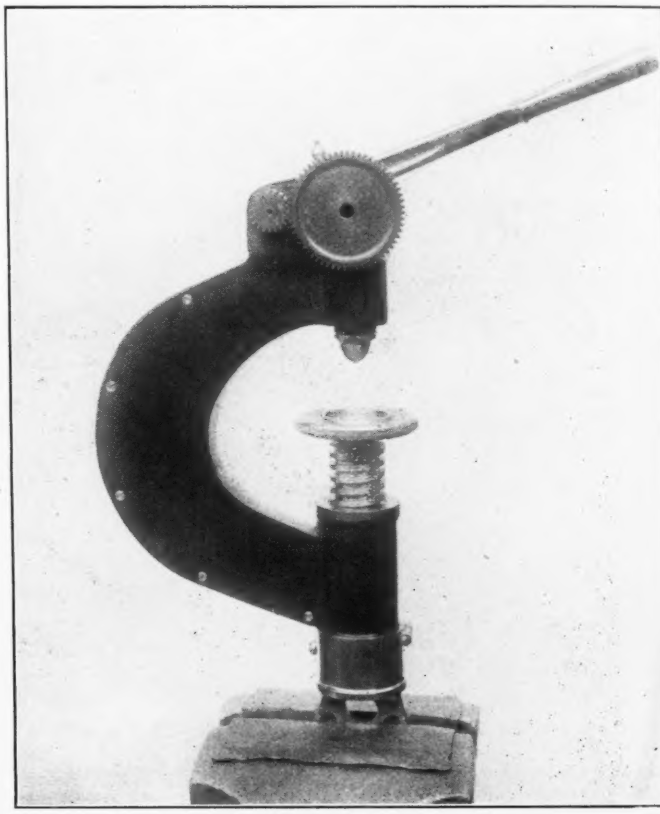
The construction of the machine is based on the principle of elasticity of the frame, which for this purpose has been given the shape of a horseshoe. The power produced by the pressure of the ball on the test piece has a tendency to open the frame to a certain degree in proportion to this power. The shape of the frame has therefore been specially considered in order to have it as elastic as possible. The pressure of 3,000 kgs. does not at all change the resistance or elasticity of the frame, as it is made of an air hardening, nickel-chrome steel, having an elastic limit of 242,000 lb. per sq. in., and a pressure of 3,000, 4,000 or 5,000 kgs. does not stress it above 10 kgs. per sq. mm. (14,423 lb. per sq. in.). Under these conditions, repeated tests even in large numbers do not alter at all the calibration of the machine.



Machine Ready for Testing

The deflection of the frame being relatively small (1 to 1.5 mm.), a register, the construction of which resembles a metal manometer, is installed in the hollowed out part of the frame. By means of a needle and a graduated dial, the deflection and therefore the pressure exerted in making the test, can be quickly and easily read.

To adjust the machine all that is necessary is to open the case enclosing the mechanism above the frame. Should the machine ever get out of adjustment, a comparison should be made on the standard piece, and when an impression of the same diameter has been made, the needle should be brought over the figure 3,000 by means of a small adjusting screw. This adjustment, however, would only be necessary through some accidental cause independent of the operation of the machine under normal usage.



Arrangement of the Gears at the Rear of the Derihon Portable Hardness Testing Machine

The second illustration shows the arrangement of the gears at the rear. A portable case is provided in which the machine can be packed.

This machine is placed on the market by H. A. Elliott, 507 Majestic building, Detroit, Mich.

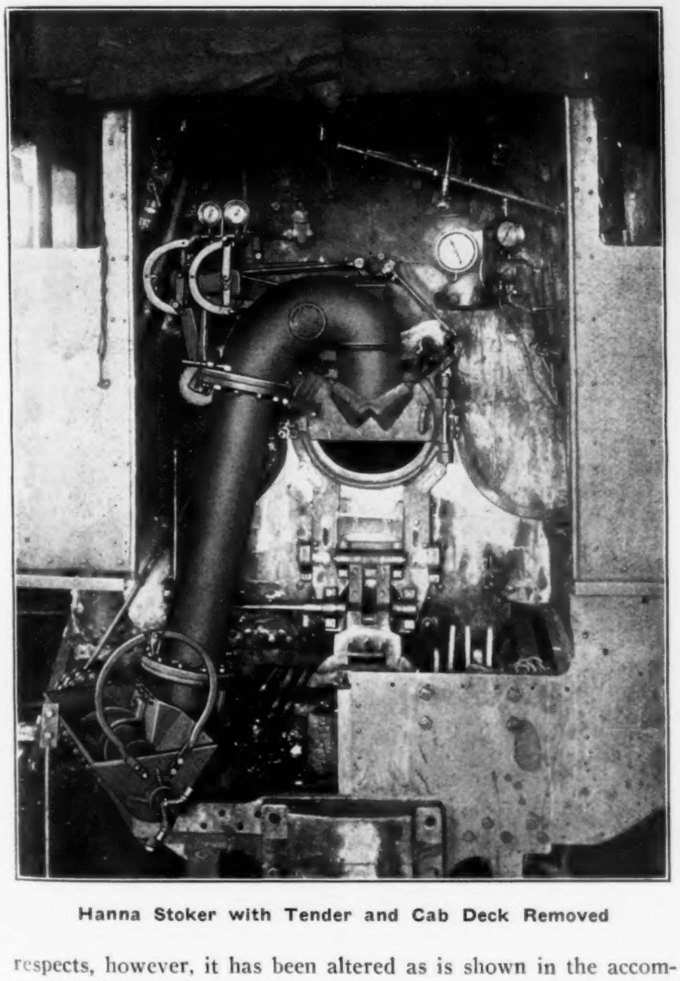
Chinese as Workmen.—Of all original workmen, states Eastern Engineering, the Chinese are undoubtedly the best, though there may be some with experience of both races who may be disposed to give the palm to the Japanese. A European who thoroughly understands his business, and who is able to impart his knowledge and his instructions in a clear manner to his Chinese subordinate, and who, moreover, is blessed with a little patience and tact, will find little difficulty in the management and control of Chinese labor of whatever kind. Speaking generally, they are good and conscientious workmen, and many indeed are very clever fellows. The quality of the work turned out by a good Chinese fitter, turner, or machine man varies little from that of the average good British workman of the same class, but the latter would beat him in point of time.—*The Engineer.*

Improved Hanna Locomotive Stoker

Conveys the Coal from the Tender and Discharges Through the Fire Door with Original Distributing Device

The Hanna Locomotive Stoker was fully illustrated and described on page 121 of the April, 1911, issue of the American Engineer & Railroad Journal. That machine was arranged so that it was necessary for the fireman to shovel the coal from the tender to a hopper and the stoker simply delivered it to the firebox and distributed it over the grate area. A number of machines of this kind were applied and successfully operated for some time, but owing to the requirement of shoveling the coal by hand, it did not receive an extensive application. One of the original stokers, however, which was fitted to a large Mallet locomotive on the Carolina, Clinchfield & Ohio, has remained in operation during the past three years and has successfully fired this large locomotive during that time.

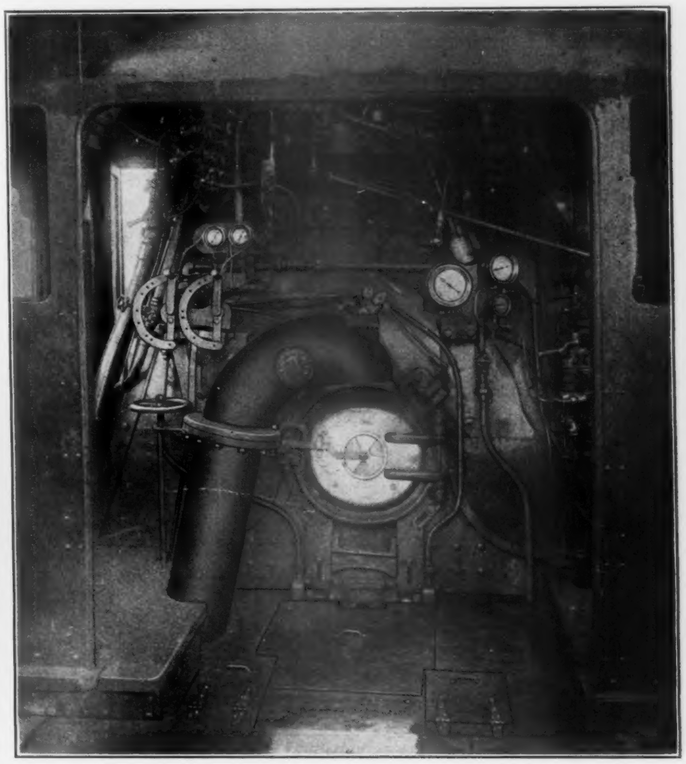
The Hanna Locomotive Stoker Company, Mercantile Library Bldg., Cincinnati, Ohio, realizing the necessity of having the stoker convey the coal from the tender as well as to distribute it in the firebox, proceeded to redesign its machine to accomplish this object. The improved stoker maintains the original construction, arrangement and operation so far as the distribution of the coal after it reaches the fire door is concerned. In other respects, however, it has been altered as is shown in the accompanying illustrations.



Hanna Stoker with Tender and Cab Deck Removed

One of the new machines was applied to a Mallet locomotive on the Carolina, Clinchfield & Ohio and has been in regular service for a number of months. A preliminary test was made with this locomotive to ascertain the advantage in connection with fuel economy of using a stoker fired engine as compared with hand firing, both with and without the brick arch. The locomotive tested was a 2-6-6-2 type having a total weight of 342,650 lb. The cylinders were 23 in. and 35 in. by 32 in. stroke and the engine has 57 in. drivers. It carries a steam pressure of 200 lb. and develops a tractive effort of 70,640 lb. A 6 in. diameter exhaust nozzle was in use.

In the test without the brick arch over a .5 per cent grade, trains of about 3500 tons were drawn. The average speed in miles per hour for the hand fired was 8.44 and for the stoker fired 7.4. The most interesting figure of the test was the total evaporation per pound of coal from and at 212 deg.; this for the hand fired was 7.95 lb. and for the stoker fired was 8.54 lb., an increase of .56 lb. or 7.39 per cent. Similar tests with the brick arch gave an equivalent evaporation for hand firing of 8.94 lb. and for stoker firing of 9.52 lb. This is an increase in favor of the stoker of 6.72 per cent.



Cab of a Locomotive Equipped with a Hanna Stoker

In the new design of stoker there is a small vertical, two cylinder, reversible steam engine located on the tender and placed on the right side in the space usually occupied by tools. The flat portion of the coal space is replaced by a conical hopper, at the bottom of which is the screw conveyor. This allows all of the coal in the tender to feed to the conveyor by gravity. In the illustrations this hopper is shown as covered with removable strips but in practice they were found to be unnecessary and have been removed.

The steam engine drives the conveyor through a clutch and bevel gears to a shaft which extends diagonally across under the tender deck and parallel to the screw conveyor. This shaft connects to the conveyor on the tender by means of spur gears at the back end. The tender conveyor partially crushes the coal against knives located at the outlet from the hopper and carries it forward toward the left side of the locomotive to a point above the end sill of the tender frame. Here there is a ball and socket joint and a sheet iron pipe through which the

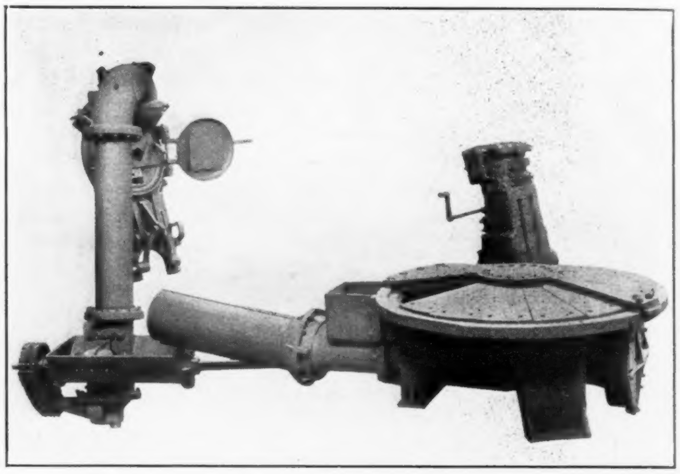
coal is crowded and falls to the hopper of the feeding conveyor.

At the forward end of the shaft which drives the tender conveyor there is a universal joint and it continues and drives a short section of spiral conveyor which is arranged with left hand spirals on either side of a cover plate that is directly opposite the opening to the vertical conveyor. This short section of conveyor is employed for the purpose of feeding the vertical. An extension of the shaft beyond the feeding hopper, through a double sprocket wheel and short sections of chain, conveys the power to a shaft underneath which in turn drives the vertical conveyor by a bevel gear.

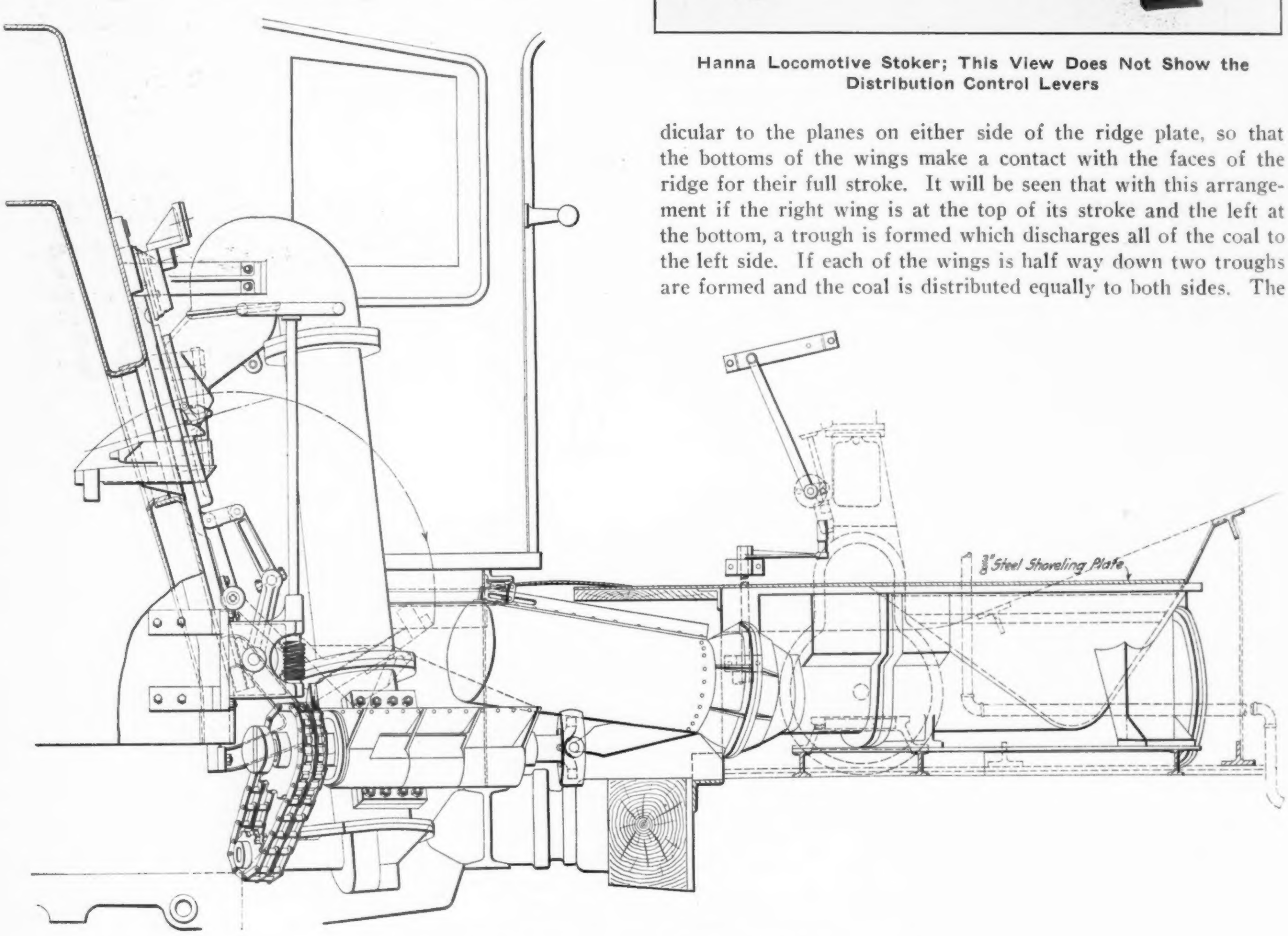
The vertical conveyor is enclosed in the cast iron pipe shown in the illustration which passes through the cab deck on the left hand side and close to the boiler head. At the top of this pipe is a short elbow section and the coal is forced through this by the pressure from behind and falls into the distributing apparatus by gravity.

The section of the stoker carrying the distributing wings is arranged to latch to a swinging ring hinged on the regular fire door pin, allowing this to be swung open for observation, hooking or even hand firing as though it was a regular swinging door, while at the same time automatically disconnecting or connecting the wing controlling mechanism through a slot and pin. If it is desired to have the full opening of the fire door for any purpose, this wing section can instantly be detached from the ring and laid aside by one man and the section of the distributing apparatus which contains the steam jets is arranged to swing beneath the deck by an operating wheel in the cab. The deck opening is covered by a sheet iron plate. This allows the regular fire door, which is in place on the right hand side, to be closed against the ring and used in the ordinary manner. The pipe coming up at the left does not in any way interfere with the work of hand firing.

The distributing apparatus is unique and consists of two sets of jets, there being seven arranged in an arc, each being at the end of a cast iron finger. Below these is a very thin narrow opening through which a flat jet of steam emerges. Above these jets is a ridge plate slanting downward and on either side of this are wings swung from hinged connections arranged perpendicular to the planes on either side of the ridge plate, so that the bottoms of the wings make a contact with the faces of the ridge for their full stroke. It will be seen that with this arrangement if the right wing is at the top of its stroke and the left at the bottom, a trough is formed which discharges all of the coal to the left side. If each of the wings is half way down two troughs are formed and the coal is distributed equally to both sides. The coal, after passing into these troughs is dropped in front of the steam jets and the fine particles will pass between the fingers and be caught by the flat jets below. This is normally maintained at about 20 lb. less pressure than the jets emerging from the fingers and the fine dust is thus discharged to the firebox underneath a stronger jet, which tends to hold it down until it is consumed. The larger pieces, however, strike the fingers and are caught by the jets at the ends and the pieces are thus blown



Hanna Locomotive Stoker; This View Does Not Show the Distribution Control Levers



Complete Hanna Stoker in Position on a Locomotive

to various parts of the firebox, depending on the direction of the jet which catches each. The distribution is thus controlled by the wings, which are very ingeniously operated and will permit a definite amount of coal to be fed to different parts of the firebox continuously.

The adjusting levers for these wings are shown at the left side in the view of the interior of the cab. By moving the handles along the arc, the travel of the wings on either side of the ridge plate is controlled and these wings can be made to continuously follow any determined path. If, for instance, it is found that the locomotive is burning stronger on the right side than on the left, the right hand wing will be arranged to travel from the bottom of its stroke two-thirds of the way up and back again while the left hand wing will be arranged to travel from a point two-thirds down, to the top and back. In this way a greater proportion of the coal will be distributed on the right hand side and a smaller proportion on the left. This adjustment, together with the control of the pressure of the steam in the

Hanna Stoker Ready for Hand Firing

jets, allows great flexibility and it is possible to so adjust them as to suit the burning conditions of any locomotive.

The capacity of this machine for firing depends altogether on the speed at which it is operated.

At the present time a Hanna stoker of this type is also in operation on a 12-wheel locomotive on the Norfolk & Western and the preliminary runs are reported as being very successful.

Kansas Fuels.—The fuels of Kansas include coal, petroleum and natural gas. The coal mining industry has been an important one for the past 40 years, and at present furnishes employment for about 13,000 men. The amount mined in this period is 2.2 per cent. of the total known deposit, and at the average rate of the past five years it will take 762 years to exhaust the supply.

Standardization.—Extension of the practice of standardizing many parts of the locomotive, particularly those requiring frequent repairs or renewal, is general. Even the practice of standardizing whole locomotives so as to greatly reduce the number of classes in service, with an accompanying large improvement in the maintenance account and in the conditions of operation, is found on the more progressive roads.—*Railway Age Gazette.*

LENOX SERPENTINE SHEAR

The new type of shear shown in the illustration has been perfected by the Lenox Machine Company, Chicago, Ill., and is designed particularly for the straight and irregular cutting of sheets and plates.

The frame is a steel casting of spiral construction designed to provide sufficient clearance for material of unlimited length or width. It will not only allow straight cutting, but also in or out curves having a minimum radius only slightly larger than the diameter of the blades. The spiral steel frame carries all gearing and is mounted on a cast iron base.

The blades are made of high grade tool steel, and are set in approximately a horizontal plane. This gives a very large

A New Serpentine Shear

cutter bearing on the sheet or plate, and consequently, there is very little distortion in the cutting. The upper cutter is positively driven, while the lower is mounted in an adjustable sleeve, so that its position may be varied to allow for different thicknesses of material and for redressing. In addition, a cam is provided so that the lower blade can be dropped enough to permit the removal of sheets without reversing the machine. The cutters have a flush fastening to the shaft and no nut projects to interfere with the handling of the work. The knurled edges feed the sheet automatically into the machine. A tool steel pin is provided to take up the end thrust on the lower cutter shaft.

Where a number of sheets are to be cut to the same pattern, a template may be bolted to the work and this template followed by guiding against the top cutter.

The machine is driven by a two-speed pulley, giving slow speed for intricate curve cutting and high speed for straight work. The main drive shaft is extended and squared on one end so that a hand crank may be used if necessary.

The shear illustrated has a capacity for cutting No. 10 gage

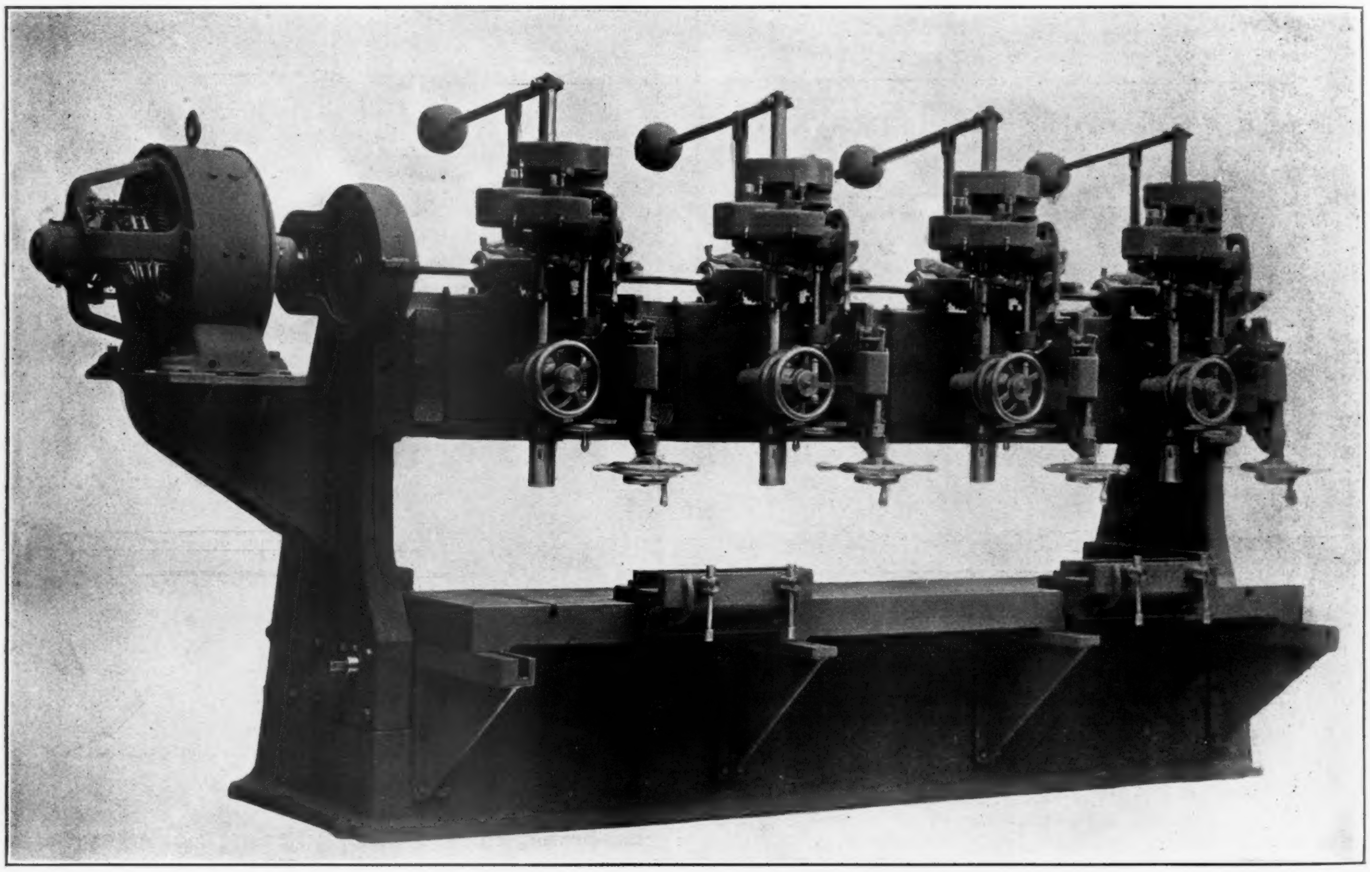
material and lighter, while other sizes having capacities of No. 16 gage, ¼ in. and ⅜ in. material can be furnished. All machines are arranged for either belt and hand power or direct motor drive.

Joseph T. Ryerson & Son, Chicago, are the selling agents for the company.

MUD RING AND TUBE SHEET DRILL

A four-spindled drill designed by the Foote-Burt Company, Cleveland, Ohio, for use in boiler shops was illustrated on page 619 of the November, 1913, issue of this journal. In this machine the four independent heads were mounted in pairs on auxiliary cross rails which allowed the drills to reach a minimum center distance of 8 in. in each pair.

A somewhat more elaborate machine has been installed in the Juniata shops of the Pennsylvania by the same company and is shown in the illustration. It is used principally for drilling the rivet holes around the firebox mud ring, and tube holes in the boiler tube sheets. The four heads of the machine are entirely independent of each other and are arranged to have an in and out adjustment from the main cross rail for a distance of 12 in. They are also adjustable on the main cross rail up to a minimum center distance of 18 in. Both of these adjustments are controlled by the individual hand wheels shown in front of each slide.



Four Spindle Drill for Mud Rings and Tube Sheets

The heads carrying the spindles are complete in themselves, as each is arranged with a clutch for stopping and starting. Each is fitted with geared power feed with adjustable stop for automatically stopping it at any desired point. Two changes of power feed are provided on each head, either one of which is available by shifting a conveniently located lever. In addition to the power feed, each spindle is furnished with a hand feed through a worm gearing.

The main rail is very heavy and of box form. The base is of continuous box section and the table is arranged with T slots and fitted with removable mud ring chucks, the same as in the smaller machine. It also has an in and out motion of 36 in. controlled by a lever at either end of the machine.

This drill is motor driven. A Westinghouse 20 h. p. motor with speed adjustment from 375 to 1,500 r. p. m. is geared direct to the driving shaft by a large spur gear and a rawhide pinion, both of which are guarded. The weight of the machine is 23,000 lbs.

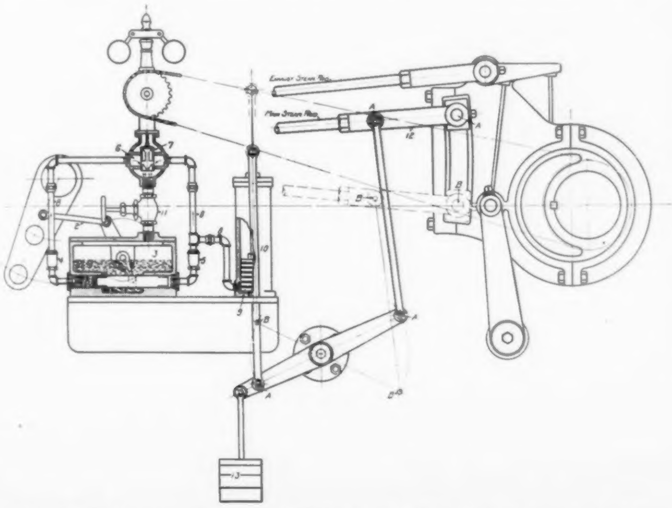
CROSS COMPOUND AIR COMPRESSOR FOR THE LACKAWANNA

The Delaware, Lackawanna & Western has installed at its Kiser Valley shops at Scranton, Pa., a new class M-CSC two-stage compressor recently placed on the market by the Chicago Pneumatic Tool Company, Chicago. This compressor has steam cylinders 19 in. and 31 in. by 26 in. The air cylinders are 28 in. and 17 in. The compressor is rated at 2,500 cu. ft. of free air per minute at 135 r. p. m., which is the maximum speed for which the air and steam valves and ports are designed. The steam and exhaust valves are of the Corliss type, being operated by a simple system of links connected to wrist plates, which in turn are driven by eccentrics on the crank shaft.

The chief feature of this machine is its economical operation from a fuel standpoint. It has a lower steam consumption than a machine of the cross-compound type with the Meyer gear. It is interesting to note that a railroad in the position of the Lackawanna, located as it is in the coal district, finds it practical to purchase a compressor of low steam consumption in an endeavor to save fuel.

The frames of this compressor are of the full Tangye type, having a box case which is fully enclosed. The main bearing and guide barrel are cast in a single piece extending to the founda-

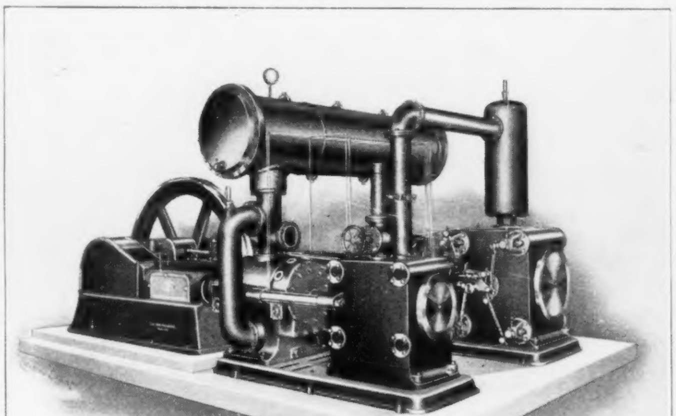
tion. The air cylinders are bolted directly to the frame with the steam cylinders behind and in line with them. They are held in alinement by two heavy tie rods and are further anchored to box-shaped sole plates extending under the steam and compressor cylinders. The foundation bolts secure the main frame and the sole plates only, the cylinders resting on the finished faces of the sole plates to which they are secured by heavy bolts. This arrangement will permit any of the cylinders being



Speed Governor and Speed Regulator for Cross Compound Air Compressor

removed and returned to correct alinement without disturbing the frame.

The frame and guides are enclosed, which permits of complete flood lubrication for all main bearing points. Both the steam and air cylinders are made large enough to ensure two reborings with perfect safety. The air valves in the cylinder head are so located as to be easily accessible for examination or renewal. The inlet valves are placed at the bottom of the cylinder head and are of the Corliss oscillating or rolling type, with unusually



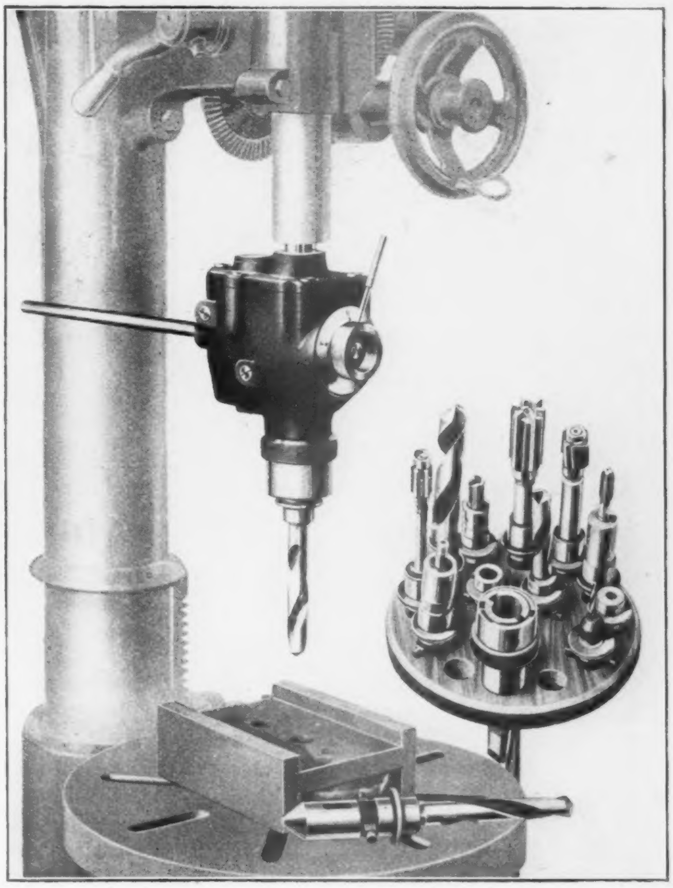
Cross Compound Air Compressor for the Lackawanna

large port openings and small clearance with consequently free direct inflow of air. The discharge valves are of the mushroom type. The steam valves are of the Corliss oscillating type. The exhaust admission valves operate independently of each other. The exhaust valves have a fixed opening and the steam valves are regulated according to the speed and load requirements.

One of the most interesting features in the design of this machine is the speed governor and pressure regulator. As shown in the illustration, the high and low pressure valve gears are each operated by one eccentric, the rods being connected to different points on the eccentric straps, thus giving independent drives to the valves. The high pressure steam gear, working in a link, has an adjustable setting; *A* and *B* show the maximum and minimum cut-off points. The position of this rod is controlled by the governor which operates as follows: A positively operated plunger pump driven by the air rocker arm and a lever *2*, pumps oil from the reservoir *3*, through the check valves *4* and *5* into the chamber *6*, through the valve *7*, and again to the reservoir *3*. The position of the valve *7* is controlled for speed by centrifugal force, and for pressure by a pressure cylinder, similar to the regular speed and pressure governor. An increase in the speed or air pressure gradually closes the valve *7*, causing the oil pressure in the pipes *8* to rise. This increase of oil pressure raises the plunger *9* against the weight *13*, changing the position of the link *12* from position *A*, in the direction as shown by position *B*, thus reducing the point of cutoff. When the air pressure drops, the valve *7* opens, reducing the oil pressure in the cylinder *10*, allowing the weight *13* to drop and increase the point of cut-off in the direction as indicated by *A*. Valve *11* is for adjusting the amount of oil opening for the maximum speed of the machine.

VARIABLE SPEED AND REVERSING ATTACHMENT

An attachment for drill presses which provides three speeds and a reverse for the drill without change in the adjustment of the drill press, is shown in the accompanying illustration. These



Variable Speed and Reversing Attachment for Drilling

changes of speed or reversing are made without stopping the machine and provide for the convenient use of different sizes of drills and taps in the same hole or in the same vicinity. This attachment is carefully built of high grade materials. There

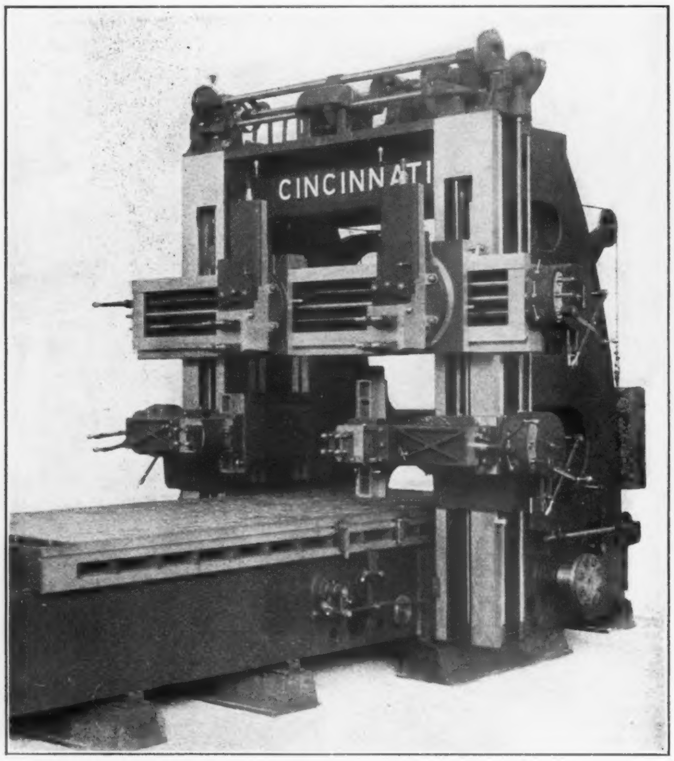
are no sliding gears and the transmission is effected by two hardened and positive-acting clutches. All the gears are of hardened steel and the loose gears run on phosphor-bronze bushings. The direct speed is the same as the spindle speed, the intermediate speed is about two and one-half times faster than the direct and the high speed is about five times faster.

This attachment, as ordinarily furnished, includes a Wizard chuck which permits the changing of all sizes and kinds of tools without stopping the machine, but it can also be obtained with a No. 3 Morse taper hole or a stub arbor so that any other style of chuck can be used if desired. It is built by the McCrosky Reamer Company, Meadville, Pa.

CINCINNATI CYLINDER PLANER

On page 102 of the February, 1914, issue of this journal there appeared a description of an 84 in. planer designed by the Cincinnati Planer Company, Cincinnati, Ohio, which included a number of new and original features.

The same company has also perfected a machine which is specially adapted for planing locomotive cylinders. This is made in a 72 in. by 72 in. size and contains all the improvements and conveniences of the 84 in. machine previously illustrated. It has rapid power traverse to all heads in any direction, and all movements are independent of each other and can be made whether the table is in motion or not. Reference can be made to the previous description for the



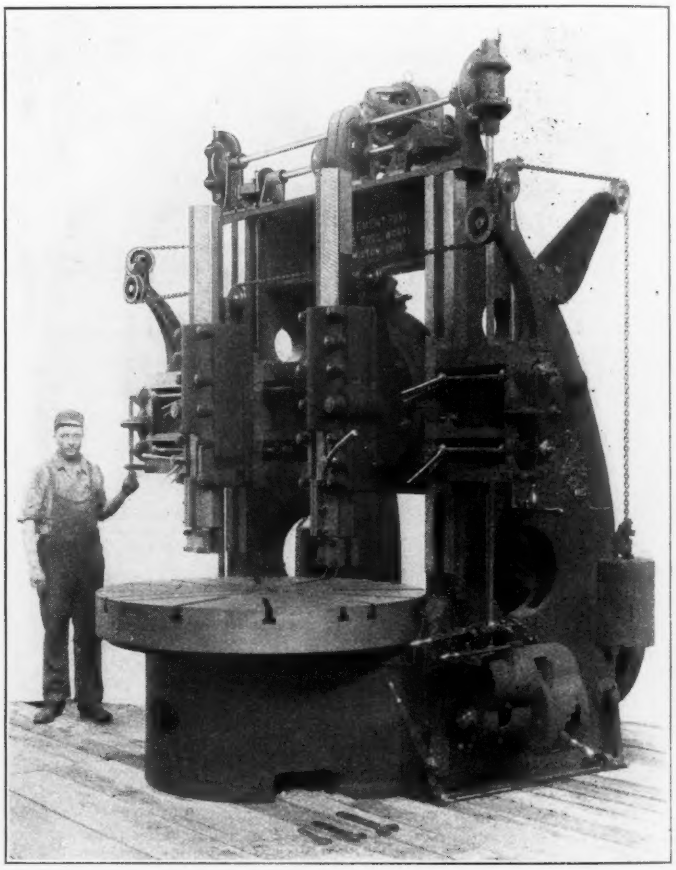
Cylinder Planer with Rigid Side Heads

arrangement of the parts and the other features of special interest.

The specially added feature in the cylinder planer is the extra side head supports which take the form of brackets rigidly bolted on the inside of the housing, and which support the side cutting heads while planing the frame fits, etc., on cylinders. These brackets are adjustable in height and can be used in any position between the top of the table and the bottom of the cross rail. A sliding shoe fits the front face of these brackets and has a dovetail support for the cross slide on the side heads. This construction eliminates all twisting strains on the housing face usually caused by the long overhung slide and the upward pressure of the tool. These brackets can be easily removed from the machine, thus converting it to a standard planer.

BORING AND TURNING MILL

The Niles-Bement-Pond Company, 111 Broadway, New York, has recently re-designed its Niles boring and turning mill. The new machine has centralized control, all changes of speed and reversal being within reach from the operator's position. One lever disengages the feed, engages the fine and coarse feeds and



Improved Design of Niles Boring and Turning Mill

operates the fast traverse in either direction. Power reverse traverse to saddles and bars in either direction is provided. The hand adjustment of saddles and bars is by automatic releasing ratchets located at the sides of the saddles. No part of the machine extends below the floor line and no special foundation is required. The housings are of box girder form, double webbed and without openings in the front face, the cross rail elevating screws being located between the housings. They are securely bolted to the bed and tied together at the top by a heavy brace. The table is deep and strongly ribbed and is supported by an annular bearing of large diameter running in a bath of oil. The cross rail is of the three track type, having a narrow guide at the bottom with the saddle traversing screw located between the guiding surfaces. Power adjustment is provided. The saddles have wide bearings on the cross rail with provision for taking up wear by means of taper gibs. A clamp bolt is provided for clamping each saddle when the bar is feeding.

The feeds are eight in number, are positive, continuous and reversible. They are independent for each head, both in amount and direction for down, cross and angular feeding. The counterweights for each bar are attached to the same chain, but act independently. The counterweight chain is placed at the rear of the

bars to prevent interference from overhead cranes when handling work on and off the table. Safety friction clutches located on the vertical spline shafts insure against accidents, in case the heads or bars meet with obstruction when either feeding or fast traversing. All shafts are of high grade steel and the drive is bushed throughout with bronze. Taper gibs are used to take up the wear on sliding surfaces. All driving, feeding, fast traversing and elevating gears are of liberal diameters.

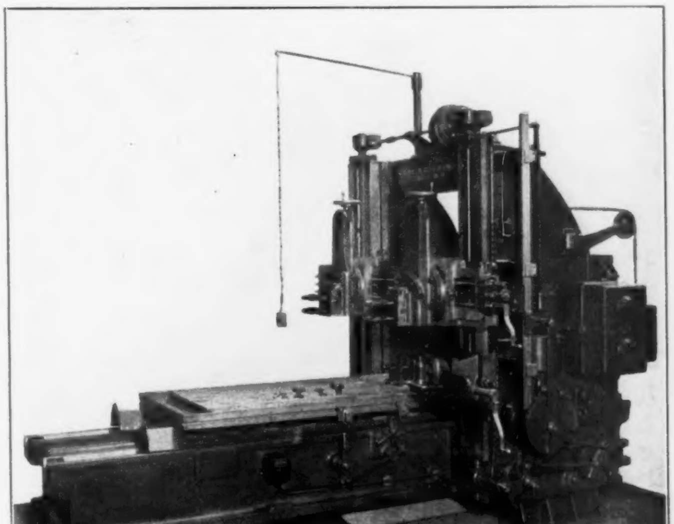
The motor drive by direct current is by a motor of 4 to 1 speed variation, carried on a drive plate in the rear between the housings. Power is transmitted through a double run of clutch gears, giving two mechanical changes in speed, which, with the usual 16 or more speeds in the controller gives 32 or more speeds to the table. The motor is fitted with push-button control and a dynamic brake for the table. A separate motor, located on the top brace of the mill, is furnished for elevating the cross rail and providing rapid power traverse to bars and saddles. Belt drive through a single pulley or alternating current motor drive by constant speed motor is provided through a speed box and back gear located in the rear of the mill, giving 12 changes of speed. The belt driven machines are built on the convertible plan, and may be readily changed to motor drive.

These machines are built in 44, 53, 62 and 73 in. sizes, the horse power of the motors required ranging from 7.5 to 12.5.

STANDARD 48 INCH PLANER

The accompanying illustration shows the latest development of standard double housing type planer built by the Detrick & Harvey Machine Company, Baltimore, Md. This machine is a very rigid type of straightforward planer which measures 50 in. between the housings and 50 in. between the table and the crossrail when it is at the highest position. The reciprocating motion of the table is obtained through the medium of a spur gear.

The bed of the machine is of the two V-way type with a closed top. There is an opening in the top of the bed to allow the gears to be placed in the machine or taken therefrom while on the foundation, but the metal extends under and around the gearing so that it may run in oil. The centers of the V-ways are 26 in. apart and the width across the top of each V is 5½ in. The included angle of the ways is 110 deg.



Detrick and Harvey Standard Planer

A box type table with a continuous bottom plate is supplied. It is 40 in. wide and 10 in. in depth over the ways. The table rack is semi-steel, cut from a solid bar and bolted and keyed to the table. The width of the rack is 7 in.

The crossrail has a vertical face of 16¼ in., a depth of 7 in. opposite the housings and is 16 in. in depth between the housings. The power movement of the crossrail is through a frictional device. On the crossrail there are two cutter heads with the tool posts slightly offset so as to bring them close together. The tool slides have a vertical adjustment of 16 in. by hand and an automatic power feed in all directions. There are two side tool heads which have independent automatic power feeds vertically in either direction and hand adjustments on the housings.

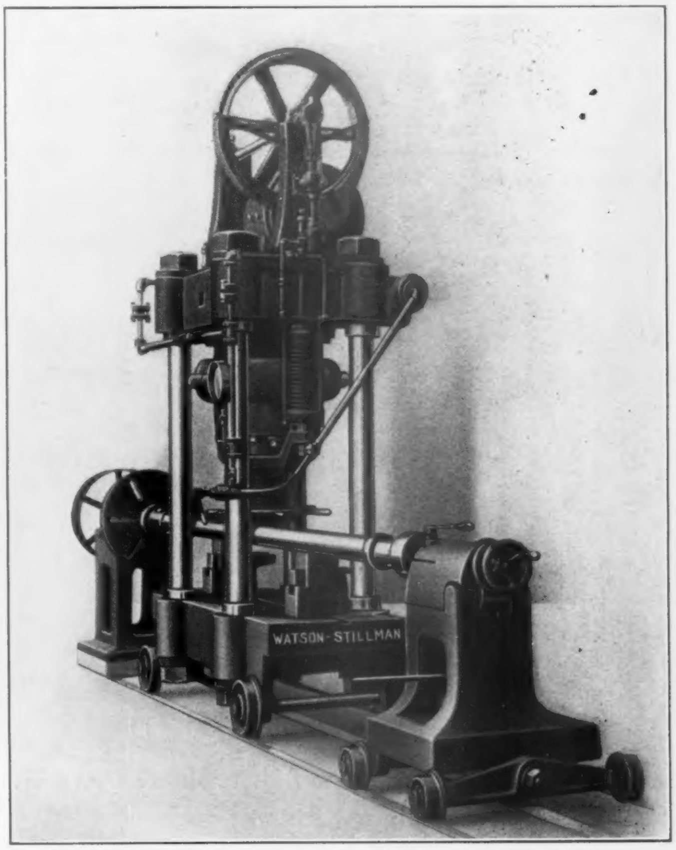
A positive friction type feed mechanism is employed and it has sufficient power for feeding the four heads simultaneously. It is designed to slip under undue strain and to consume power only while feeding.

The illustration shows the operating side of the machine and the motor is mounted on the floor on the opposite side. The machine shown in the illustration has a reversing type motor drive. It will be seen that the control switch for starting and stopping the motor is carried to a convenient point over the center bed from an overhanging conduit.

HYDRAULIC SHAFT STRAIGHTENER

A hydraulic press that has a capacity of 325 tons, which is sufficient for taking the bends out of any steel shaft up to 10 in. in diameter, has recently been produced by the Watson-Stillman Company, 50 Church street, New York City. The length of the shaft is limited only by the extent of the foundation provided.

This is a motor driven self contained unit, requiring no outside air or hydraulic system. There are three independent parts; the head stock which is stationary, and the press and tail stock, which are on rollers to permit their adjustment to varying lengths of shafts. The bed rails are flush with the floor so that when not in use the movable parts can be rolled to one side, leaving the floor clear of obstructions. The head and tail stocks are similar to those of a lathe, except that the centers

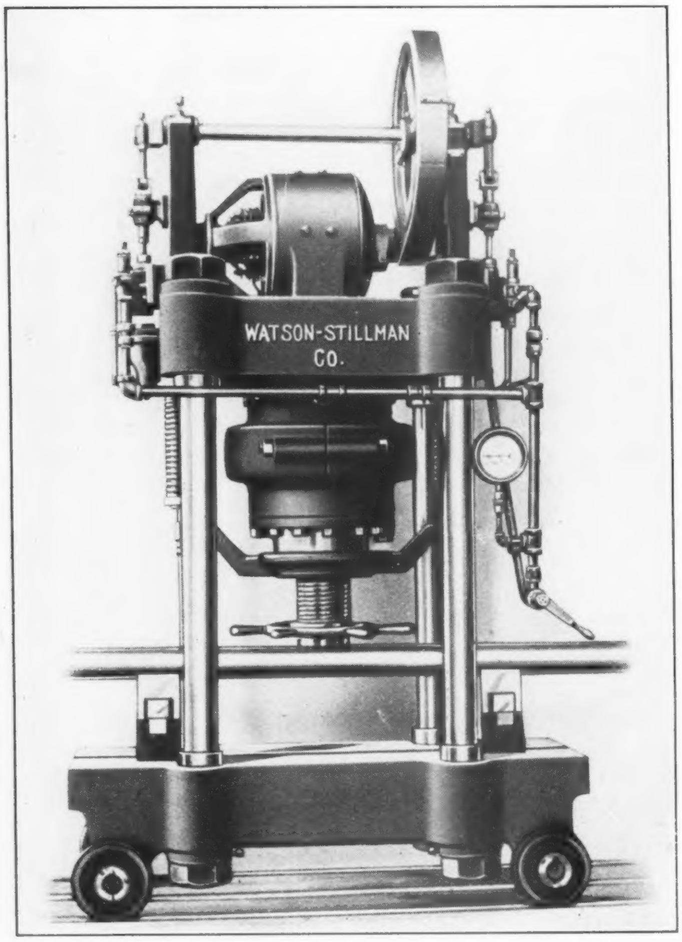


Shaft Straightener Showing Supports for the Ends of the Shaft

are hinged to follow the movement of the shaft ends when the bend is made. The shaft is revolved from the head stock and the "high point" marked. The press is then moved to that point and the bending blocks adjusted.

The ram has a maximum movement of two inches, the return movement being effected by springs. Screwed concentrically into the ram is a square threaded adjustment screw, which compensates for the different diameters of the shafts and also enables the operator to predetermine the flexure desired. This eliminates all danger of overbending.

The entire hydraulic power plant, including five-horsepower motor, pump, reservoir, etc., is mounted on the top platen of the press. The floor space required is 3 ft. 6 in. wide by the length of the shaft, plus 6 ft. The total net weight of the press is 19,300 lb.



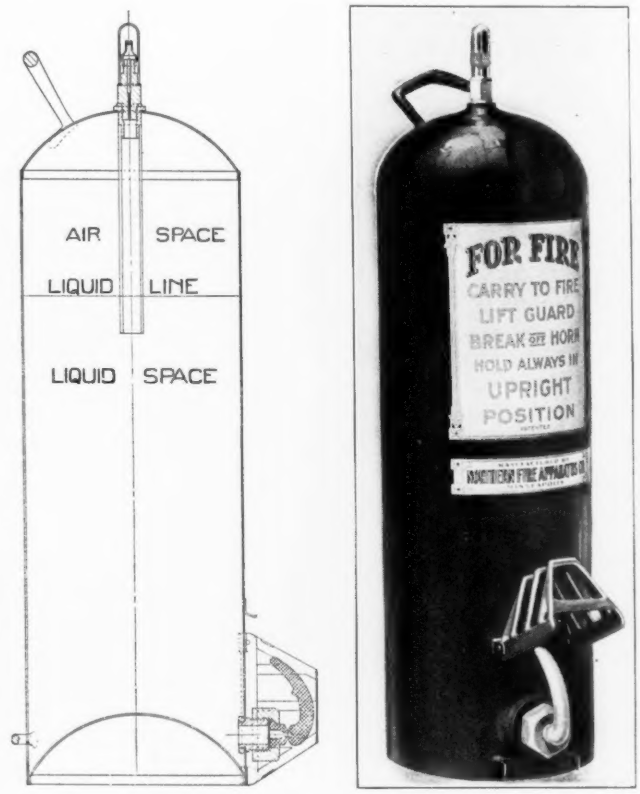
A Closer View of the Shaft Straightener

Canadian Wireless.—When the new chain of wireless stations, now in course of construction by the Canadian government, is finished and in operation it will be possible for a passenger on any incoming steamship to communicate from mid-ocean as far inland as Fort William, Ont.

Circulation in Refrigerator Cars.—Not only must a refrigerator car be well built and well insulated, but the icing arrangement must be such that the cold air will be well circulated throughout the car. Proper circulation will not only keep the contents of the car at a uniform temperature, but will also carry away the moisture given off by the contents, which, of course, is necessary for the protection of the contents, especially fruit and vegetables. When these products are loaded in a refrigerator car without any precooling it is usually advisable to ventilate the car to the first icing station in order to eliminate the moisture given off by the warm products.—*Railway Age Gazette.*

FIRE EXTINGUISHER

The illustrations show a portable fire extinguisher which is adapted for use in railway service. These extinguishers are made of steel and are charged with a chemical consisting of a calcium chloride solution filled to a height shown in the drawing as the liquid line. Compressed air is then applied through the special Schrader air valve, the air passing down through the brass tube which extends below the liquid line and provides a liquid seal to the air valve. To operate, the horn shaped lead nozzle at the bottom of the tank is broken off, the shield first being raised. This makes a clean cut opening into the tank and the air pressure will force the liquid out for a distance of 25 ft.



Fire Extinguisher Operated by Air Pressure

To fill the tank the liquid is poured through the spug at the bottom and a new lead nozzle is applied. The compressed air is pumped in through the valve at the top, a gage being used to determine the correct amount of pressure. The air may be pumped in with a standard tire pump. This air valve also permits of frequently testing the air pressure by means of a standard tire tester. If any leak should occur in the air valve and thereby reduce the required pressure the liquid would be forced up through the valve, clearly indicating that it was not properly seated. The lead horn is protected by the nozzle guard, which is shown raised in the photograph. This extinguisher is made by the Northern Fire Apparatus Company, Minneapolis, Minn.

Passenger Coaches in Sweden.—There appears to have been considerable development in the Swedish coach in recent years. The new models are much longer and heavier than the old four wheel type, and the swiveled truck is coming into general use. The compartment prevails, but a corridor is run along the inside of the coach at one side. Sleeping cars are arranged in the same way. Vestibuled coaches are run through from the Continent, but cannot be said to be in general use in Sweden. Gas is generally used for lighting and steam for heating in the better class of equipment.—*The Engineer.*

NEWS DEPARTMENT

The paint and coach shops of the Wabash at Moberly, Mo., and ten coaches were destroyed by fire on March 9.

The Illinois Central has taken out a building permit for a hospital at Fifty-eighth street and Stony Island avenue, Chicago, to cost $400,000.

On the Delaware, Lackawanna & Western in 1913, the weight of mails carried exceeded by 23 per cent the quantity carried in 1912, while the increase in compensation received was only 6.19 per cent.

At Bakersfield, Cal., March 16, Maurice Rice, 17 years old, rode a mile on a motorcycle in 51 seconds, doing the feat on a dirt track. On the same track Rice has ridden his machine 67 miles in one hour.

On the Chicago & North Western at Manlius, Ill., March 13, robbers who tried to steal freight from a train standing near the station, shot and killed the engineman and wounded two deputy sheriffs; and one of the robbers was killed.

The Gulf, Colorado & Santa Fe has ordered a hospital car costing $10,000, which will be kept at Cleburne, Tex. The car is to be fitted up with an operating room and equipped to take care of from fifteen to twenty patients at one time.

The mail car of train No. 11 on the Southern Railway was robbed on the night of March 5, near Columbia, S. C. The robber intimidated the mail clerk with a pistol, secured a number of sacks of registered mail and jumped off the train.

The Superior Court at Bridgeport, Conn., has sustained the plea of ex-President Mellen's counsel that the indictment of Mr. Mellen for manslaughter in connection with the derailment at Westport in 1912 is defective, but the state's attorney will now file an amended complaint.

The New York Central has applied to the New York State Public Service Commission, Second district, for relief from the law which requires it to use oil fuel in locomotives in the Adirondack forest preserves. Operating expenses were increased, in one year, by the use of oil, in the sum of $106,201. The road declares that with suitable precautionary measures it will be safe to use coal.

The Pennsylvania has decided to lay wires underground between New York and Philadelphia, 90 miles, and the directors have authorized the immediate commencement of the work on the 25-mile stretch between Trenton and Rahway, appropriating $300,000 for this purpose. By the storm of March 1, all the company's electrical communication was suspended between New York and Philadelphia more than two days.

H. C. Nutt, chairman of the central safety and efficiency committee of the San Pedro, Los Angeles & Salt Lake, announces a 50 per cent reduction in the number of personal injuries to employees in January as compared with December, and also a reduction of over 50 per cent in the number of train accidents during January as compared with December. The safety first movement was started on this road on November 1. During the month of November there were 75 personal injuries to employees, in December 68 and in January only 34. Only one-half of the 34 were serious enough to be reported by telegraph.

THE WESTINGHOUSE MEMORIAL ASSOCIATION

An organization has been formed at Pittsburgh, Pa., composed of the friends of the late George Westinghouse, with the purpose of erecting in that city a memorial of some kind to Mr. Westinghouse. The president of the association is Col. H. G. Prout. It is proposed to open a popular subscription.

A NEW INFORMATION BUREAU

The eastern railroads are to establish a bureau of information, with headquarters in New York City. The function of the bureau will be to make permanent the machinery for gathering, classifying and recording information such as was collected by the conference committee in connection with the recent arbitrations on employees' wages. John G. Walber, assistant to the third vice-president of the Baltimore & Ohio, and head of the efficiency, discipline and employment departments of that road, will have charge of the bureau, which will probably be started April 1.

GOVERNMENT RAILROAD IN ALASKA

The Alaska Railway bill, providing for the construction of a thousand miles of railroad by the government and the expenditure of $35,000,000, has been passed by both houses of Congress, the Senate having adopted recently the conference report already adopted by the House. President Wilson has already indicated his approval of the bill; and tentative plans for proceeding with the work of construction have been considered at the Interior Department. Secretary Lane, long an advocate of the project, is prepared to go ahead with it as soon as the President gives the word. The report of the conference committee appointed to settle differences between the two houses was adopted in the Senate by a vote of 42 to 27.

The measure authorizes the construction of not more than one thousand miles of railroad to connect Alaska's coal fields with the coast, the route to be selected by the President. He is to decide whether or not existing railroad lines in the territory shall be bought to be made a part of the government system, and whether the road is to be operated by the government or leased, after it is built.

The House eliminated from the bill a provision authorizing a bond issue of $35,000,000 to finance the railroad and to be paid off by the proceeds of government land sales in Alaska, and under the amended measure the project will be financed out of the current funds in the treasury. Congress will have to appropriate each year the amount necessary for construction.

The bill provides for the construction of a road "not to exceed 1,000 miles, to be so located as to connect one or more of the open Pacific ocean harbors on the southern coast of Alaska with the navigable waters in the interior of Alaska, and with a coal field or fields yielding coal sufficient in quality and quantity for naval use, so as to best aid in the development of the agricultural and mineral or other resources of Alaska."

LORD STRATHCONA'S BEQUEST TO YALE

The gift of $500,000 to Yale University in the will of the late Lord Strathcona is made "as an expression of his appreciation of the benefits he gained from investments in the United States, particularly from the St. Paul, Minneapolis & Manitoba and the Great Northern railways." The will directs that the money shall be used for "the promotion of the modern sciences and for instruction in the practical questions arising from the application of scientific knowledge to the industrial, social and economical problems of the time, it being my special desire to have the said sum expended so far as in the opinion of my trustees may be deemed advisable for instruction in civil and mechanical engineering, with special reference to the construction, equipment and operation of [instrumentalities of] transportation of

passengers and freight, whether by land or water, and the financial and legislative questions involved." The university is empowered to equip buildings or to endow chairs for the promotion of these ends, and the giving of scholarships in the scientific or graduate department is provided for. In awarding these scholarships preference is to be given to persons who for two years or more have been creditably connected with the railway companies above named, as officer or employee, and to their children.

MEETINGS AND CONVENTIONS

Chief Interchange Car Inspectors' and Car Foremen's Association.—The annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association will be held at Cincinnati, Ohio, August 25, 26, 27, 1914.

New Haven Railroad Club.—This is the name of an organization recently started at New Haven, Conn., with the object of promoting railroad knowledge and encouraging social relations and acquaintance among the different departments of the New York, New Haven & Hartford. The first regular meeting, followed by a dinner, was held at the Railroad Young Men's Christian Association in New Haven, March 16. The membership thus far is made up of officers, chief clerks, assistant chief clerks and bureau foremen; but the constitution appears to be liberal, not excluding any class. The temporary president is T. M. Prentice. Permanent officers will be elected at a meeting to be held April 21.

The June Conventions.—The exhibit committee of the Railway Supply Manufacturers' Association, in planning for the June conventions, held a meeting in Pittsburgh a short time ago. At that time 85 per cent of the exhibit space was assigned, which compares very favorably with the record at the same time for previous years. There are now available a very few booths in Machinery Hall, and some space in the Machinery Hall extension and Exhibit Hall. Every year more or less disappointment is caused because late comers find all of the space assigned and are unable to exhibit. It is suggested that all those who wish to exhibit made immediate application; as applications are coming in now it will be only a short time before all of the space is taken.

Railway Storekeepers' Association.—At the eleventh annual convention of the Railway Storekeepers' Association, to be held at Washington, D. C., in the Hotel Raleigh, Monday, Tuesday and Wednesday, May 18, 19 and 20, 1914, papers will be read on the following regular subjects: Stores Department Expenses; How to Obtain the Greatest Efficiency from Employees in the Stores Department; Handling of Stationery, and Classification of Electric Railway Materials. There will be committee reports on Recommended Practices, Accounting, Piece Work, Standardization of Tinware, Stationery, Uniform Grading and Inspection of Lumber, Scrap Classification, Membership, Standard Buildings and Structures, Book of Standard Rules, and Marking of Couplers and Parts.

New England Railroad Club.—At its annual meeting and dinner on March 10, the New England Railroad Club elected the following officers: President, H. E. Astley, roadmaster, N. Y. N. H. & H.; vice-president, P. M. Hammett, superintendent of motive power, Maine Central; secretary, William E. Cade, Jr.; treasurer, C. W. Sherburne, Boston; finance committee, H. E. Astley, B. M. Jones and F. A. Barbey; executive committee, H. E. Astley, P. M. Hammett, C. W. Sherburne, C. B. Breed, associate professor, M. I. T., W. J. Cunningham, assistant to the president, N. Y. N. H. & H., George W. Wildin, mechanical superintendent, N. Y. N. H. & H.; E. W. Holst, superintendent of equipment, Bay State Street Railway; W. C. Kendall, superintendent of car service, B. & M.; J. B. Hammill, superintendent, B. & A.; F. A. Ryer, purchasing agent, B. & A.; J. D. Tyter, general superintendent, B. & M.; L. J. Morphy, designing engineer, B. & A.

International Engineering Congress, 1915.—Rapid progress is being made in working out the final program of papers for the International Engineering Congress, to be held in San Francisco in 1915. The first volume of the publication of the congress will consist of a series of articles descriptive of the various technical features of the design and construction of the Panama canal. Subscriptions to the Congress are being received daily and on March 1 the number of enrollment was slightly in excess of 1,200, of which over 200 are from foreign countries and about 1,000 from the United States. Subscription blanks have been mailed through the various national societies to many thousands of engineers in this country and through the foreign societies to foreign engineers. The response already received is very encouraging, but it is trusted that all engineers interested in the success of the congress will not fail to send in their subscriptions as early as possible. Delay in so doing renders the task of the committee of management more difficult, and makes it impossible to form any just estimate of the receipts which may be expected and the number of copies of the volumes which will have to be published.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 5-8, 1914, Detroit, Mich.

American Railway Master Mechanics' Assoc.—J. W. Taylor, Karpen building, Chicago. Convention, June 15-17, 1914, Atlantic City, N. J.

American Railway Tool Foremen's Association.—A. R. Davis, Central of Georgia, Macon, Ga. Convention, July 20-22, 1914, Hotel Sherman, Chicago.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Convention, December, 1914, New York.

Car Foremen's Association of Chicago.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio. Convention, August 25-27, 1914, Cincinnati, Ohio.

International Railway Fuel Association.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 18-22, 1914, Chicago.

International Railway General Foremen's Association.—William Hall, 829 W. Broadway, Winona, Minn. Convention, July 14-17, 1914, Hotel Sherman, Chicago.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio. Convention, August 18-20, 1914, Milwaukee, Wis.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention, May 25-28, 1914, Hotel Walton, Philadelphia, Pa.

Master Car Builders' Association.—J. W. Taylor, Karpen building, Chicago. Convention, June 10-12, 1914, Atlantic City, N. J.

Master Car and Locomotive Painters' Assoc. of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention, September 8-11, 1914, Nashville, Tenn.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention, May 18-20, 1914, Hotel Raleigh, Washington, D. C.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, August, 1914, Chicago, Ill.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	....	....	....	Jas. Powell	Room 13, Windsor Hotel, Montreal.
Central	May 14	....	....	H. D. Vought	95 Liberty St., New York.
New England	Apr. 14	Physical Valuation of Railroads	L. R. Pomeroy	Wm. Cade	683 Atlantic Ave., Boston, Mass.
New York	Apr. 17	Art of Locomotive Staybolts	C. A. Seley	H. D. Vought	95 Liberty St., New York.
Pittsburgh	Apr. 24	Braking Power	Walter V. Turner	J. B. Anderson	207 Penn. Station, Pittsburgh, Pa.
Richmond	Apr. 13	Locomotive Capacity and Superheated Steam	G. E. Ryder	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Apr. 10	The Vision of the Railroad Man	Dr. E. H. Higbee	B. W. Frauenthal	Union Station, St. Louis, Mo.
Southern & S'w'r	....	....	....	A. J. Merrill	218 Grant Bldg., Atlanta, Ga.
Western	....	....	....	Jos. W. Taylor	1112 Karpen Bldg., Chicago, Ill.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

WILBUR M. BOSWORTH, whose appointment as mechanical engineer of the Louisville & Nashville, with headquarters at South Louisville, Ky., was announced in the March issue, was born on June 13, 1879, at Baltimore, Md., and graduated from the Baltimore Polytechnic Institute in 1898. He began railway work in July of the same year as a special apprentice on the Baltimore & Ohio at the Mt. Clare shops and three years later became draftsman at the same place. From January, 1906, to October, 1911, he was chief draftsman of the same road and then was appointed mechanical engineer of the Kansas City Southern, with headquarters at Pittsburg, Kan., leaving that position on March 1, to go to the Louisville & Nashville as mechanical engineer as above noted.

MILLARD F. COX, mechanical engineer of the Louisville & Nashville, has been appointed assistant superintendent of machinery, with headquarters at Louisville, Ky.

J. F. DUNN has been appointed superintendent of motive power of the Oregon Short Line, with headquarters at Salt Lake City, Utah.

R. PRESTON, master mechanic of the Manitoba division of the Canadian Pacific at Winnipeg, Man., has been appointed assistant superintendent of motive power of the Western Lines, with headquarters at Winnipeg.

W. E. RICKETSON has been appointed mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Beech Grove, Ind., succeeding C. A. Brandt, promoted.

J. H. RUXTON has been appointed superintendent of motive power of the San Antonio, Uvalde & Gulf, with headquarters at Pleasanton, Tex.

GEORGE ST. PIERRE, master mechanic of the San Francisco-Oakland Terminal Railways, has been appointed superintendent of equipment, with office at Oakland, Cal.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

CHARLES F. BARNHILL has been appointed master mechanic of the Beaumont division of the Gulf, Colorado & Santa Fe, with headquarters at Silsbee, Tex., succeeding A. B. Adams, deceased.

A. BARROW has been appointed assistant road foreman of engines of the Pere Marquette, with headquarters at Grand Rapids, Mich.

F. BAUER has been appointed master mechanic in charge of the central division motive power work of the Cleveland, Cincinnati, Chicago & St. Louis at the Beech Grove shops, Indianapolis, Ind.

JOHN BAUER has been appointed master mechanic of the Alton, Jacksonville & Peoria, with headquarters at Alton, Ill.

C. A. BRANDT has been appointed master mechanic of the Chicago, Michigan and the Peoria & Eastern divisions of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Indianapolis, Ind.

W. G. COOPER has been appointed road foreman of engines of the Wabash, with headquarters at St. Thomas, Ont.

J. COOTS has been appointed supervisor of locomotive operation of the Erie, with headquarters at Jersey City, N. J.

W. H. DRESSEL has been appointed master mechanic of the Oregon-Washington Railroad & Navigation Company, with headquarters at Portland, Ore.

G. A. GALLAGHER has been appointed master mechanic of the Illinois Southern, with headquarters at Sparta, Ill.

C. F. GREGORY has been appointed master mechanic of the St. Louis & O'Fallon, with headquarters at St. Louis, Mo.

L. F. HAMILTON has been appointed district master mechanic of the Canadian Pacific, with headquarters at West Toronto, Ont.

W. H. HOFFMAN has been appointed master mechanic of the Chicago & North Western, with headquarters at Green Bay, Wis.

W. B. KILGORE has been appointed road foreman of engines of the Cincinnati, Hamilton & Dayton at Lima, Ohio, with jurisdiction between Troy, Ohio, and Toledo.

A. F. KING has been appointed road foreman of engines of the Wabash, with headquarters at Peru, Ind.

W. J. LLOYD has been appointed master mechanic of the Oregon Short Line, with headquarters at Pocatello, Idaho.

M. J. MCGRAW has been appointed master mechanic of the Chicago & Alton at Bloomington, Ill.

J. W. MAHON has been appointed master mechanic of the Kanawha & West Virginia, with headquarters at Charleston, W. Va.

D. J. MALONE has been appointed master mechanic of the Oregon Short Line, with headquarters at Salt Lake City, Utah.

WILLIAM NAYLOR has been appointed road foreman of engines of the Chicago & Alton at Bloomington, Ill., succeeding W. H. Davies.

F. NICHOLSON has been appointed master mechanic of the Louisiana Railway & Navigation Company, with headquarters at Shreveport, La., succeeding M. F. McCarra, resigned.

W. J. RENIX has been appointed district master mechanic of the Canadian Pacific at Cranbrook, B. C., succeeding F. R. Pennyfather, promoted.

GEORGE ROSS has been appointed master mechanic of the Oregon-Washington Railroad & Navigation Company, with headquarters at La Grande, Ore.

L. RUKEL has been appointed road foreman of engines of the Wabash, with headquarters at Moberly, Mo.

J. S. SHEAFE, engineer of tests of the Illinois Central, has been appointed master mechanic of the Staten Island lines of the Baltimore & Ohio, with headquarters at St. George, Staten Island, N. Y.

B. STRAUSS has been appointed road foreman of engines of the Minnesota division of the Rock Island Lines, with headquarters at Cedar Rapids, Ia.

J. A. TSCHUON has been appointed master mechanic of the Baltimore & Ohio at Washington, Ind.

J. E. WILSON has been appointed road foreman of engines of the Pere Marquette, with headquarters at Grand Rapids, Mich.

T. E. WOLFE has been appointed road foreman of engines of the Pere Marquette, with headquarters at Grand Rapids, Mich.

ROBERT E. WOOD has been appointed road foreman of equipment of the El Paso and Mexico divisions of the Rock Island Lines with headquarters at Pratt, Kan., succeeding Edward Robertson, transferred.

L. WOSTER has been appointed master mechanic of the Cincinnati, Hamilton & Dayton, with headquarters at Ivoryville, Ohio.

CAR DEPARTMENT

H. I. DORNER has been appointed general car foreman of the Toledo Terminal Railroad, with headquarters at Toledo, Ohio.

H. H. GERBACK has been appointed car foreman of the Great Northern at Great Falls, Mont.

J. A. Moore has been appointed car foreman of the Canadian Pacific at White River, Ont.

S. D. Page has been appointed general car foreman of the Bangor & Aroostook, with headquarters at Milo Junction, Me.

W. H. Pinson has been appointed general foreman of the car department of the San Antonio, Uvalde & Gulf, with headquarters at Pleasanton, Tex.

SHOP AND ENGINE HOUSE

H. Alaman, master boiler maker of the Vandalia at Terre Haute, Ind., has retired on a pension after having been in the service of the company for 49 years.

W. F. Black, shop draftsman and apprentice instructor at the Oswego, N. Y., shops of the New York Central & Hudson River, has been transferred in a similar capacity to Avis, Pa., succeding Harry S. Rauch, promoted.

Charles Boertman has been appointed superintendent of shops of the Pere Marquette, at Saginaw, Mich.

W. A. Deems has been appointed general foreman of the Glenwood shops of the Baltimore & Ohio, at Pittsburgh, Pa.

C. Fife has been appointed locomotive foreman of the Great Northern, at Casselton, N. D.

H. P. Forsberg has been appointed shop foreman of the Chicago & North Western at Superior, Neb.

James H. Gaston has been appointed general foreman of the Georgia Railroad at Augusta, Ga.

W. H. Keller has been appointed general foreman of the locomotive and car shops of the Cincinnati, Hamilton & Dayton, with headquarters at Lima, Ohio, succeeding W. A. Deems, promoted.

N. J. Lawhon has been appointed day roundhouse foreman of the Rock Island Lines at Manly, Iowa, succeeding H. P. Jones, assigned to other duties.

Charles Lynch has been appointed boilermaker foreman of the Rock Island Lines at Manly, Iowa.

A. G. McClellan has been appointed foreman of locomotive repairs of the Chicago & Alton at Bloomington, Ill., succeeding W. H. Wundrie.

H. F. Martyr has been appointed general foreman of the Manly, Iowa, shops of the Rock Island Lines, succeeding L. H. Huxton, resigned.

J. Q. Myers has been appointed locomotive foreman of the Great Northern at Grand Forks, N. D.

Harry S. Rauch has been appointed general foreman of the New York Central & Hudson River shops at Avis, Pa. Mr. Rauch was born in Michigan in 1874, and served an apprenticeship as a machinist from 1891 to 1894. For the next seven years he was employed as a machinist by the Ames Iron Works Company, Oswego, N. Y. In 1901 he took a position at the Oswego shops of the New York Central & Hudson River as a machinist, and from 1904 to 1913, except for two years when he served as general manager of the Ontario Chemical Company of Oswego, he was shop draftsman and apprentice instructor at Oswego. In 1913 he was transferred to Avis, Pa., in a similar capacity, which position he held until the above mentioned appointment.

H. C. Rowley has been appointed general foreman of the Zanesville & Western at Fultonham, Ohio.

John Simmes has been appointed general foreman of the shops of the Cincinnati, New Orleans & Texas Pacific at Ludlow, Ky., succeeding J. G. Lewis.

G. W. Thomas has been appointed roundhouse foreman of the Southern at Selma, Ala., succeeding J. A. Wilkins, transferred.

W. Wade has been appointed shop foreman of the Chicago & North Western at Janesville, Wis.

H. M. Warden has been appointed general foreman of the locomotive department of the San Antonio, Uvalde & Gulf, with headquarters at Pleasanton, Tex.

J. A. Wilkins, roundhouse foreman of the Southern Railway at Selma, Ala., has been transferred to Birmingham, Ala.

PURCHASING AND STOREKEEPING

F. J. Angier has been appointed storekeeper of the Baltimore & Ohio at Green Spring, W. Va.

T. H. Barker has been appointed storekeeper of the Baltimore & Ohio at Benwood, W. Va., succeeding R. T. Ravenscroft.

R. M. Blackburn has been appointed acting general storekeeper of the Chicago & North Western at Chicago, Ill., succeeding W. M. Carroll.

C. D. Boice, who has been in the service of the Florida East Coast for some time, at the New York office, has been appointed purchasing agent, with headquarters at New York, succeeding L. C. Haines, promoted.

C. R. Craig has been appointed purchasing agent of the Southern Railway at Washington, D. C., succeeding E. S. Wynn, promoted.

W. J. Dunlop has been appointed storekeeper at the East Side terminal of the Baltimore & Ohio at Philadelphia, Pa., succeeding H. L. Mortimer.

J. F. Hoyer has been appointed purchasing agent of the New Orleans Great Northern, with office at Jackson, Miss., succeeding F. L. Kinsman, resigned.

W. E. Lefaivre has been appointed purchasing agent of the Denver & Rio Grande, with headquarters at Denver, Col.

George H. Robinson has been appointed purchasing agent of the Union Pacific, with headquarters at Omaha, Neb.

J. A. Turner has been appointed purchasing agent of the Mobile & Ohio at Mobile, Ala.

J. L. Woods has been appointed assistant purchasing agent of the Nashville, Chattanooga & St. Louis, with headquarters at Nashville, Tenn.

OBITUARY

Adolph Butze, formerly general purchasing agent of the Grand Trunk, died at St. Louis, Mo., on March 3, aged 68 years. Mr. Butze began railway work in 1868 with the Wabash, in whose employ he remained for some time. From 1885 to 1887 he was in the purchasing department of the Missouri Pacific, and then became private secretary to the general manager of the Chicago, Indianapolis & Louisville. He was made general purchasing agent of the Grand Trunk in 1896, retiring on January 1, 1912, under the pension rules of the company.

Edward Bourne Gibbs, formerly connected with the Union Pacific at North Platte, Neb., died on March 5 at St. Louis, Mo., aged 80 years. Mr. Gibbs was manager of power and rolling stock of the old Platte County Railroad in 1863, was master of machinery and motive power of the St. Louis & Iron Mountain in 1868, and in 1880 became connected with the Union Pacific at North Platte, Neb. Later he was in charge of the Oregon division of that road at Portland, Ore., and subsequently returned to North Platte, retiring from active service in 1904.

DANIEL EDWARD FITZGERALD, until recently assistant general superintendent of motive power of the St. Louis & San Francisco, lost his life in the fire which destroyed the Missouri Athletic Club building in St. Louis, Mo., on March 9. Mr. Fitzgerald was born at Cairo, Ill., April 20, 1869. When he was about 9 years of age he moved with his parents to a farm near Saint Marys, Kan. He attended the country schools there and later entered Saint Marys College, where he graduated at the age of 20. Immediately after graduating he went to Horton, Kan., with the Rock Island as clerk in the store department, and later became chief clerk to the master mechanic. After a few years in this position he accepted a position with the Atchison, Topeka & Santa Fe, at Topeka, Kan., in the motive power department, and was finally made chief motive power accountant. On June 1, 1904, he left the Santa Fe and accepted the position of chief motive power clerk of the St. Louis & San Francisco in the office of the general superintendent of motive power at St. Louis. On November 19, 1904, the office was moved to Springfield, Mo., and on July 1, 1909, he was appointed assistant general superintendent of motive power. He filled this position until March 1, 1914, when he resigned to become sales manager for the Pierce Oil Corporation at St. Louis. He had been in St. Louis one week, stopping at the Missouri Athletic Club, of which he was a member, when he met death in the fire which destroyed the club building on the morning of March 9, 1914. Mr. Fitzgerald was a member of the American Railway Master Mechanics' Association and also of the Master Car Builders' Association.

D. E. Fitzgerald

D. C. IDLER, formerly for 40 years master mechanic of the Vandalia, died at Indianapolis, Ind., February 23.

WILLIAM H. THOMAS, formerly superintendent of motive power of the Southern Railway, died on March 7 at his home in Philadelphia, Pa. He was born on September 27, 1842, at Colebrook, Pa., and began railway work in July, 1865, as a foreman of a lathe gang in the shops at Renova, Pa., of the Philadelphia & Erie, now a part of the Pennsylvania Railroad. He was then consecutively roundhouse foreman, acting master mechanic and foreman of the machine shops at the same place, and then was road foreman of engines on the same road. In July, 1879, he was appointed master mechanic of the Mobile & Montgomery, and the following year became master mechanic of the Nashville & Decatur and Henderson divisions of its successor, the Louisville & Nashville. From September, 1883, for two years, he was master mechanic of the Huntington division of the Chesapeake & Ohio at Huntington, W. Va., and then became superintendent of motive power of the East Tennessee, Virginia & Georgia. From September, 1894, to February, 1896, he was assistant superintendent of motive power of its successor, the Southern Railway, and then to July, 1902, was superintendent of motive power of the same road.

INDIAN LOCOMOTIVE RECORD.—A passenger locomotive on the Great Indian Peninsula has a record of nearly 1,000,000 miles run and is still in good order, according to the Advocate of India. It was built by Neilson Reid & Co., Glasgow, in 1884.

SUPPLY TRADE NOTES

Edward A. Hawks has been appointed special representative of the department of car equipment of the Dahlstrom Metallic Door Company, Jamestown, N. Y.

Frank N. Grigg has been appointed sales agent of the Transportation Utilities Company, New York. He will have office at 1201 Virginia Railway & Power building, Richmond, Va.

George Hills has resigned as president of the Welding Materials Company, New York, to become general sales agent of the Siemund Wenzel Electric Welding Company, also of New York.

James C. Boyd, formerly chief engineer, has been elected vice-president of Westinghouse Church Kerr & Company, New York. He will have charge of all the engineering and construction activities of the company.

W. L. Anderson, formerly Chicago representative of George E. Molleson Company, New York, has been appointed manager of the railway sales department of the Union Fibre Company, Chicago.

G. W. Alden, who for the past ten years has been with the McMyler-Interstate Company, Bedford, Ohio, has resigned from that company, to become western sales manager of the Ohio Locomotive Crane Company, Bucyrus, Ohio. He will have offices in the Fisher building, Chicago.

J. N. Kinney, who has been with the American Hoist & Derrick Company, St. Paul, Minn., for the past seven years, has resigned from that company, to become eastern sales manager of the Ohio Locomotive Crane Company, Bucyrus, Ohio. He will have offices at 30 Church street, New York.

Announcement is made of the organization and incorporation of Hodgkins & Co., with offices in the Great Northern building, Chicago, for the sale of locomotive and car specialties. The officers are Edward W. Hodgkins, president and treasurer, and Charles L. Mahoney, vice-president and secretary.

H. F. Wardwell has been appointed Chicago representative of the Monarch Steel Castings Company, of Detroit, and will handle "Lion" and "Monarch" couplers and miscellaneous open-hearth steel castings in addition to his rebuilt locomotive and car business, with office at 359 Railway Exchange.

A. E. Heffelfinger has been appointed general representative for Cuba of the Richardson Scale Company, Passaic, N. J., builders of automatic weighing machinery, with headquarters at Cuba No. 76-Altos, Havana, Cuba. Mr. Heffelfinger was for a number of years with the American Car & Foundry Company.

A. H. Weston, for many years mechanical engineer of the T. H. Symington Company and located for the past two years at Rochester, N. Y., has been transferred to the sales department of that company. He will report to C. J. Symington, vice-president in charge of sales, with office at 30 Church street, New York.

Frank J. Schraeder, Jr., formerly with the Roberts & Schaefer Company, Chicago, has formed a partnership with R. E. Gurley, formerly with the T. W. Snow Construction Company, under the name of Gurley & Schraeder, to design and construct coaling stations and coal handling machinery, with offices in the Ellsworth building, Chicago.

The Permanent Manufacturers' Exhibit of Railway Appliances and Equipment now located on the twelfth floor of the Karpen building, Chicago, was discontinued on March 31; and the exhibit will be removed to the ninth floor of the Lytton building, Jackson and State streets. The exhibit will be in charge of A. Sheldon as manager, as before.

The Whiting Foundry Equipment Company, Harvey, Ill., has

arranged with S. R. Vanderbeck, 217 Walnut street, Philadelphia, Pa., to have him handle that company's complete line in Philadelphia territory. Mr. Vanderbeck also represents the Atlas Car & Manufacturing Company, Cleveland, Ohio; Orton & Steinbrenner, Chicago, and the New Jersey Foundry & Machine Company, New York.

Westinghouse Church Kerr & Company, of Montreal and New York, have been retained by the Canadian Pacific as engineers to investigate the proposed electrification of the new double-track, 5½-mile Selkirk tunnel in British Columbia. The investigations will cover in general the type of system to be installed, the relative economies of steam and water power, and the effect of the electrification upon operating conditions.

E. F. Platt, formerly connected with the Platt Iron Works, Dayton, Ohio, and C. A. Kurz, Jr., of the Kurz Laboratories, have organized The Electrolytic Gas Company at Dayton. This company has secured the Western selling agency of the International Oxygen Company of New York, and it is the intention to proceed with the installation of a number of electrolytic plants for the production of oxygen and hydrogen in different parts of the country.

Stanley W. Midgley, for several years western sales manager of the Curtain Supply Company, has been appointed general sales manager of the Acme Supply Company, with headquarters in the Steger building, Chicago, effective on March 4. Mr. Midgley has been in the railway supply business for the past twelve years, beginning with the National Car Coupler Company as general sales representative, and for the past six years he has been with the Curtain Supply Company as western representative and western sales manager, until his appointment to the present position. Mr. Midgley is the oldest son of J. W. Midgley, who was for over twenty years the commissioner of the Western Freight Association, which comprised the several railroads extending westward from Chicago and St. Louis.

S. W. Midgley

The Duff Manufacturing Company, Pittsburgh, Pa., manufacturers of Barrett track and car jacks, Duff ball-bearing screw jacks and Duff-Bethlehem hydraulic jacks, has opened an office in the Peoples Gas building, Chicago. The same company has recently appointed G. W. Parsons, district sales agent, with offices in the Pioneer Building at St. Paul, Minn. The company also announces that by mutual agreement the Fairbanks Morse Company has discontinued acting as exclusive steam railway agents for the Duff jacks.

The employees of the Westinghouse Electric & Manufacturing Company who have been in its employ for 20 years or more, held a meeting on February 21 and organized the Veteran Employees' Association of the Westinghouse Electric & Manufacturing Company. A regular business meeting was held to formulate the organization, a set of by-laws was adopted and officers elected for the coming year. A dinner followed at which the toastmaster was L. A. Osborne, vice-president. The speakers were E. M. Herr, president; Charles H. Terry, vice-president, and James J. Barrett, representing the shop. Mr. Herr and Guy E. Tripp, chairman of the board of directors, who was also present, were elected honorary members. About 325 of the employees are eligible to membership, and over 300 of these were present.

J. T. Anthony has been appointed assistant general eastern sales manager of the American Arch Company, New York. Mr. Anthony was born in February, 1883, and graduated from the Georgia School of Technology in 1902. He was then engaged in the textile manufacturing business for a few years and entered the service of the Atlantic Coast Line in 1905. In 1907 he became a draftsman in the motive power department of the Central of Georgia. He remained with that road until 1912, being closely associated with F. F. Gaines, superintendent of motive power, in the work of designing the Gaines combustion chamber. In January, 1912, he entered the employ of the American Arch Company as combustion engineer. One year later he was made assistant to the president and held that position until March 1, 1914, when he was made assistant general eastern sales manager as noted above.

J. T. Anthony

Harlow D. Savage has been appointed general eastern sales manager of the American Arch Company, 30 Church street, New York. Mr. Savage was born at Memphis, Tenn., on April 16, 1880. He received his education in the public schools of Ashland, Ky., and at Kenyon Military Academy. Since June, 1897, he has been connected with the Ashland Firebrick Company, Ashland, Ky., having reached the position of assistant secretary and that of treasurer and sales manager. While at Ashland he was at one time in charge of mines of this company and later had complete control of operation. As a part of the latter work he designed and constructed a modern electrically operated firebrick plant at Ashland. He takes up his new work with the American Arch Company, therefore, with a thorough knowledge of the manufacturing side of its business. Mr. Savage is the president of the German Mining & Manufacturing Company and of the Clinton Mining Company. He is a director of the Ashland Firebrick Company and of the Clinton Mining Company. He also holds the position of president of the Refractories Manufacturers' Association. Mr. Savage is also a military aid to the governor of Kentucky with the rank of colonel.

H. D. Savage

CATALOGS

OIL SWITCHES.—The General Electric Company, Schenectady, N. Y., has just issued bulletin No. 47,400, illustrating and describing the type F, form K12 oil switches. This supersedes a previous bulletin on this subject.

REGRINDING VALVES.—The National Tube Company, Pittsburgh, Pa., has recently issued a 14 page booklet setting forth the advantages of that company's regrinding valves. This book takes up the design and construction of these valves in the form of a series of questions with their answers.

IRON PIPE.—Bulletin No. 11B issued by the National Tube Company, Pittsburgh, Pa., is devoted to the subject of pipe. The bulletin contains 28 pages, and is arranged in the form of chapters, one of which gives a short history of pipe and the early methods of manufacture. The bulletin is completely illustrated.

BRASS FOUNDRY EQUIPMENT.—Catalog No. 108, which supersedes catalog No. 91 of the Whiting Foundry Equipment Company, Harvey, Ill., has just been issued. This deals with the brass foundry equipment manufactured by that company, which includes brass furnaces, tilting brass furnaces, crucible tongs, tumblers, etc.

INDUCTION MOTORS.—Two or three phase, 60 cycle induction motors for general use are the subject of a bulletin from the Crocker-Wheeler Company, Ampere, N. J. The illustrations show these motors as applied in a number of industries, and also give full details of the construction. Accessories are also briefly considered.

PICKLING MACHINES.—A catalog from the Mesta Machine Company, Pittsburgh, Pa., fully illustrates and describes the machines it has developed for reducing the labor and improving the results in removing the scale and other substances from the surface of metals by the chemical action of acids, an operation commonly called pickling.

BURNING FUEL OIL.—The Gilbert & Barker process for burning fuel oil under low pressure and the equipment used is fully discussed in a catalog prepared by Gilbert & Barker Manufacturing Company, Springfield, Mass. Equipment used for various purposes, especially in connections with hardening and tempering is illustrated in several styles.

CLEVIS FOR UNCOUPLING RODS.—Circular No. 66 of the National Malleable Castings Company, Cleveland, Ohio, deals with the National safety clevis and pin, a device which has been developed by that company to prevent the detaching of uncoupling rods from the coupler locking mechanism because of the loss of the cotter from the clevis pin.

ELECTRIC FANS.—The Sprague Electric Works of the General Electric Company, New York, has issued a 35 page catalog devoted to the various types of electric fans manufactured by that company. The catalog describes the different types of direct and alternating current fans with data pertaining to each one. It is well printed and illustrated.

OILSTONE GRINDERS.—The Mummert-Dixon Company, Hanover, Pa., has recently issued catalog No. 5, dealing with oilstone grinders. These machines are designed for sharpening edge tools, general grinding, beveling knives, etc. The catalog contains 30 pages, and includes line drawings and half-tone illustrations of the company's various types of grinders.

FOREIGN ROLLING STOCK.—The Gregg Company, Ltd., Hackensack, N. J., is issuing a catalog devoted principally to illustrations of the equipment it has designed and is prepared to furnish for plantation railways. This company also designs and manufactures castings, forgings and other car parts as well as portable tracks, frogs and switches, etc. for narrow gage lines.

FLOW INDICATOR.—Bulletin No. 57, issued by the Richardson-Phenix Company, Milwaukee, Wis., illustrates and describes the application of the Phenix Sight Flow Indicator to any pipe line carrying a liquid. This device indicates electrically by lighting a lamp or ringing a bell when the flow of liquid is interrupted. Several recent improvements embodied in it are described.

LOCOMOTIVE CRANES.—Illustrations showing locomotive cranes in operation occupy the larger part of the 71 page catalog being issued by The Browning Company, Cleveland, Ohio. A complete description of the design of locomotive crane developed by this company is given in the fore part of the catalog and illustrations of all the more interesting and important details are shown.

SAFETY BRAKE LEVERS.—Circular No. 65, issued by the National Malleable Castings Company, Cleveland, Ohio, is devoted to the National safety brake lever. The main feature of this lever is the provision of two safety lugs, one cast on each side just above the fulcrum pin hole, which strike against the edges of the fulcrum in case the pin comes out and prevent the lever from slipping through.

ENGINE TRUCKS.—A four page bulletin, No. 101, recently issued by the Economy Devices Corporation, 30 Church street, New York, deals with the Economy two wheel engine truck, one of the principal features of which is a bolster arrangement which gives a constant resistance to displacement. This truck was described in the Railway Age Gazette, Mechanical Edition, March, 1914, page 154.

TOOL STEEL.—An 80 page catalog from E. S. Jackman & Company, 710 Lake street, Chicago, describes the method employed by the Firth-Sterling Steel Company in making fine tool steels. It also contains a chapter on the selection of steel for different purposes and the heat treatment of the different grades of steel. Weight tables and other useful information in connection with this subject are also included.

THERMOSTATIC CONTROL FOR STEAM HEAT SYSTEMS.—The Gold Car Heating & Lighting Company, 17 Battery Place, New York, has recently issued a pamphlet dealing with the electric thermostatic control developed by that company for controlling the temperature in steam heated cars. Illustrations of the device are included, as well as the report of a comparative test between the thermostatic control and the Gold straight steam system.

CRANES AND HOISTS.—The Northern Engineering Works, Detroit, Mich., has just issued catalog No. 26, illustrating the electric traveling cranes, hand power traveling cranes and electric and pneumatic hoists manufactured by that company, as well as overhead track system bucket handling cranes and railway cranes. This is a condensed catalog, but contains references to various bulletins which more fully explain the numerous designs.

LOCOMOTIVE HOISTS.—This is the subject of a 14 page catalog, No. 105, issued by the Whiting Foundry Equipment Company, Harvey, Ill. This catalog outlines the advantages claimed for the hoists manufactured by this company for wheeling locomotives and fully describes the construction and operation. Photographs of actual installations show the different steps in operating the hoists. A list of the various railways using this type of hoist is included.

AUTOMATIC CONNECTORS.—The Robinson Coupler Company, Washington, D. C., has just issued a report of a recent test of the company's automatic air and steam hose connector made on the Great Northern at Grand Forks, B. C. This report has been very handsomely arranged; the printing is excellent and the illustrations in every case are actual photographs. The report includes comments by the Interstate Commerce Commission regarding the tests.

AIR COMPRESSOR EFFICIENCY.—The Laidlaw-Dunn-Gordon Company, Cincinnati, Ohio, is making a practice of issuing information bulletins whenever information of a definite engineer-

ing value and interest in connection with air compressors is available. The latest bulletin is No. 22, and is devoted to a thorough discussion of air compressor efficiency and the factors which control it. It contains eight pages of solid type and summarizes in the form of five conclusions.

Lock Washers.—The Reliance Manufacturing Company, Massillon, Ohio, makes nothing but Reliance lock washers and gives particular attention to the quality of material used and the most careful inspection during the manufacturing as well as the heat treatment of the material. A catalog recently issued by this company contains illustrations of a number of types of lock washers or nut locks manufactured by it, each being accompanied by a table giving the range of sizes and the prices.

Boring and Drilling Machine.—A booklet from Pawling & Harnischfeger Company, Milwaukee, Wis., is entitled, "Difficult Drilling and Boring Made Easy." It briefly describes the Pawling & Harnischfeger drilling and boring machines but is principally devoted to illustrations of difficult operations that are performed easily with this machine. In connection with each of these illustrations, which are actual photographs taken in various shops, is a brief description of the operation shown.

Governor for Motor-Driven Air Compressors.—The General Electric Company, Schenectady, N. Y., recently issued bulletin No. 44,590 under the above heading. The function of the type ML governor, described in this bulletin, is to automatically control the operation of either stationary or railway motor-driven air compressors in order to maintain air pressure in a storage reservoir between predetermined limits. This bulletin supersedes the company's previous bulletin on the same subject.

Traveling Cranes.—The new type "H" crane developed by the Pawling & Harnischfeger Company, Milwaukee Wis., has been designed with a full consideration of the new liability laws which are now in force in various states and matters of safety have been given particular attention. This crane is fully illustrated and described in bulletin No. 401 where illustrations of the various detail features show the improved construction to good advantage. The bulletin is entirely devoted to this type of crane.

Staybolt Drilling Machine.—Two leaflets from the Richmond Staybolt Drilling Machine Manufacturing Company, Richmond, Va., briefly illustrate and describe the two types of machines manufactured by this company for drilling locomotive staybolts. These are practically the same machine, one arranged in a horizontal form and the other vertically. The latter arrangement also provides a drilling machine which can be used for other purposes as well and will drill any depth hole up to 1½ in. depth and ⅜ in. in diameter.

Ball Bearings.—A full description of the different processes in the manufacture of the S. K. F. self alining ball bearing forms a part of bulletin No. 11 from the S. K. F. Ball Bearing Company, 50 Church St., New York. Other parts of this bulletin show applications of these bearings to various machines and rolling stock, some operating under the most difficult conditions of speed and misalinement. The bulletin also contains tables giving the sizes, weight, etc. of the various types of bearings manufactured by this company.

Postal Car Lighting.—The Safety Car Heating & Lighting Company, 2 Rector St., New York, is issuing a supplement to its form No. 1116, dated April 1913, in connection with postal car lighting. It is devoted to the spacing of light units for 60 ft standard steel full postal cars and is issued on account of a change made by the Post Office Department in the arrangement of registered letter cases in this size car. It contains the same form of illustrations given in the previous pamphlet, corrected according to the new requirements.

Models for Class Room Work.—A leaflet from the Chicago Mathematical Supply House, 2019 Mohawk street, Chicago, illustrates and describes the Hanstein models, Goniostat and Rotostat which are constructed for the assistance of beginners in forming correct comprehension of problems in projection, solid and descriptive geometry and mechanical drawing. These models are very unique in their arrangement and conception. The complete set allows more than 500 possible mountings in skeleton form, each of an average height of 2 ft.

Direct Current Motors.—The round type, single field coil, direct current motors manufactured by the Sprague Electric Works of the General Electric Company have been on the market for many years and are unique in that a single field coil is used to energize the poles, making the motor exceptionally simple, compact and well protected. These motors are manufactured in nine sizes from ¼ h. p. to 7½ h. p., and are fully described in bulletin No. 247 issued by the Sprague Electric Works, 527 West Thirty-fourth street, New York.

Traveling Cranes.—A 90 page fully illustrated, large size catalog is being issued by the Niles-Bement-Pond Company, 111 Broadway, New York, for the purpose of giving a general idea of the various types of cranes, trolleys and hoists built at its extensive crane works in Philadelphia. The catalog shows first the principal details of the Niles standard electric crane in a very complete manner. Each important part of the construction is illustrated and fully described. The latter part of the catalog is largely devoted to illustrations of many different types of cranes, trolleys and hoists in operation, there being a brief note under each photograph stating its location and any special features of interest in connection with that particular installation. Many of these illustrations are taken from railroad shops.

Pyrometers for Superheated Steam Locomotives.—The value of an accurate knowledge of the temperature of the steam at the steam chest of a superheated steam locomotive in connection with its influence on the proper operation by the engineer has been recognized on foreign railways for a number of years. The comparatively few installations of pyrometers that have been made in this country quickly demonstrated that it is of equal value under American conditions. The Locomotive Superheater Company, therefore, has, after a long series of experiments and tests, finally developed a thoroughly practical pyrometer equipment which is now being fitted to a number of superheater locomotives. A circular from that company illustrates this equipment and describes its construction, installation and operation. In addition to the circular, the same company has issued an instruction book which describes the equipment in detail and gives full explanations of how to apply, adjust and maintain it.

Street Locomotive Stoker.—The type C stoker of the Locomotive Stoker Company, 30 Church St., New York, is fully illustrated and described in a recent catalog. This new design differs from the previous type B only in the steam engine which runs it and in the sprocket wheel casing. The type B machine had a constant speed engine and a gear box on the elevator for throwing the screw conveyor in and out of gear and for changing the speed at which it runs in relation to the elevator. The type C has an engine which can be run at seven different constant speeds, varying from 400 r. p. m. to 600 r. p. m. and is equipped with a friction clutch which will permit the stopping of the elevator while the engine continues in operation. The gear box used on the type B has been omitted on the type C machine and this connection is now fixed. The friction clutch on the type C is one of the most important improvements in the new machine as it furnishes a means for instantly stopping the flow of coal to the firebox and leaving the elevator buckets filled with coal ready to begin feeding again when the clutch is thrown in. Furthermore, the speed changing device gives the fireman absolute control of the quantity of coal to be fed to the fire. This design is most fully illustrated and thoroughly described in the catalog.